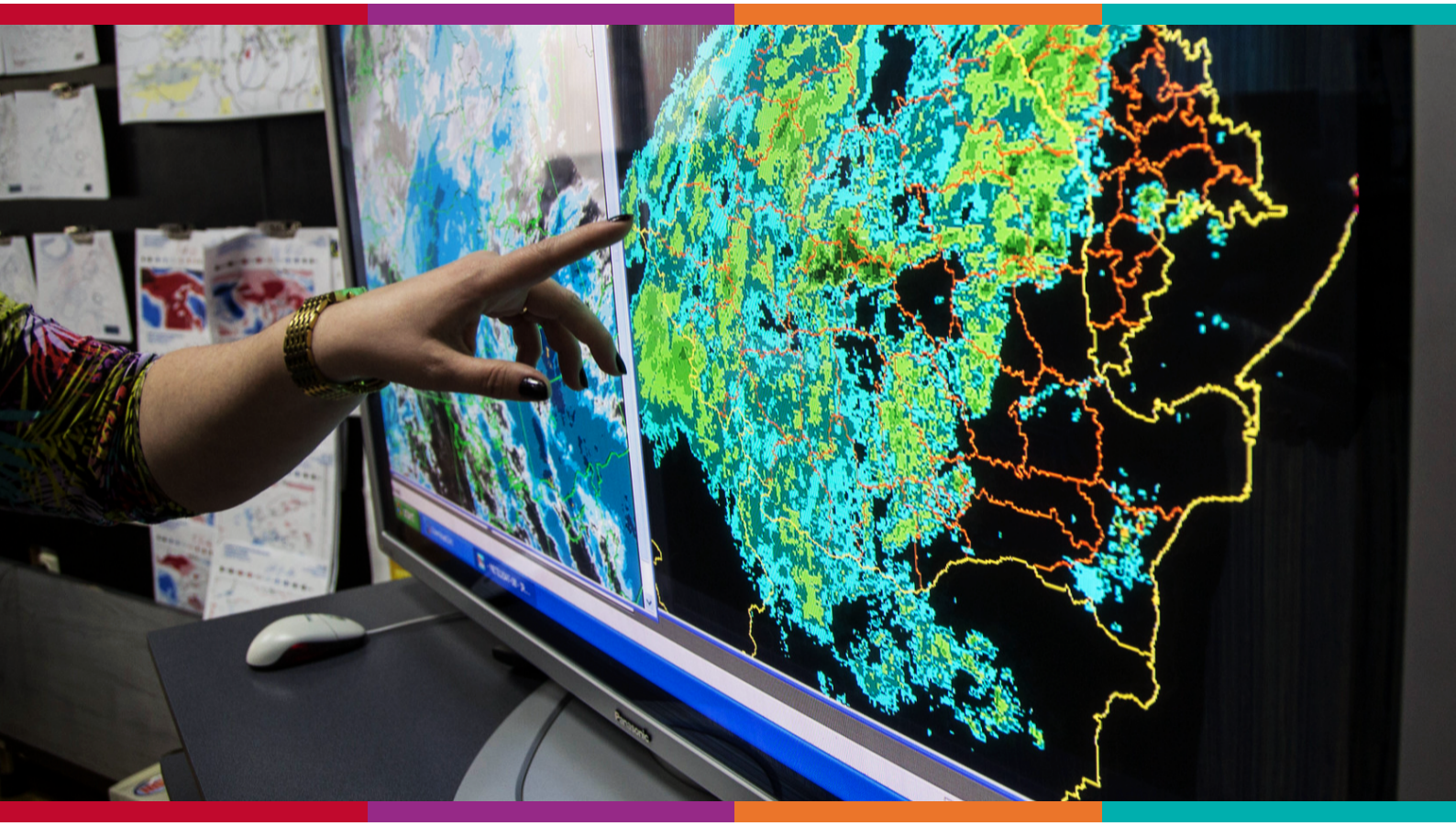
European Science & Technology Advisory Group

Socioeconomic and Data challenges

Disaster Risk Reduction in Europe



UNDRR

UN Office for Disaster Risk Reduction

SENDAI FRAMEWORK

FOR DISASTER RISK REDUCTION 2015-2030

Acknowledgments

This report was made possible thanks to the instrumental engagement and contributions of the experts composing the European Science and Technology Advisory Group. Acknowledgments go also to the Sendai National Focal Points who actively contributed to the understanding of European contexts, the experts and scientists who took part of the survey and the interview, as well as the European Commission for its support.

Authors

Dr. Alexander Altshuler
Prof. Dilanthi Amaratunga
Dr. Elena Arefyeva
Prof. Mauro Dolce
Ms. Jenny Sjastad Hagen
Dr. Blaž Komac
Dr. Massimo Migliorini
Ms. Jadranka Mihaljević
Dr. Jaroslav Mysiak
Dr. Urbano Fra Paleo
Dr. Mark Pelling
Dr. Jean Louis Rossi
Prof. Alexander Siegmund
Dr. Zvonko Sigmund
Dr. Jörgen Sparf
Ms. Sara Alonso Vicario

Editors

Dr. Jörgen Sparf
Dr. Massimo Migliorini

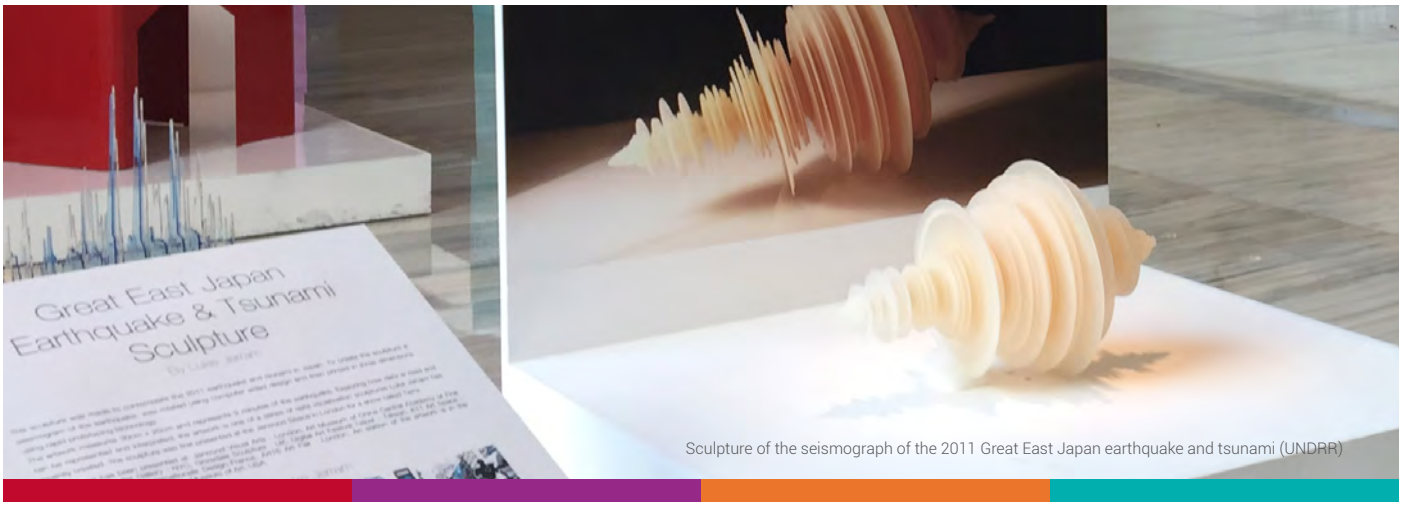
Contributors

Mr. Ian Clark
Mr. Abhilash Panda
Mr. Sébastien Penzini

Graphic Designer

Mr. Alexandru Radulescu

Table of contents



Sculpture of the seismograph of the 2011 Great East Japan earthquake and tsunami (UNDRR)

The European Science & Technology Advisory Group

The European Science & Technology Advisory Group (E-STAG) was established in April 2018, with the aim to address the need for a better inclusion of the science and technology communities in disaster risk reduction (DRR) efforts, and as called by the Sendai Framework for Disaster Risk Reduction 2015–2030 (hereafter the Sendai Framework).

In 2018-2019, the E-STAG was composed of 14 experts nominated by Member States (Armenia, Azerbaijan, Belgium, Croatia, Germany, Israel, Italy, Montenegro, The Netherlands, Russian Federation, Slovenia, Spain, Sweden, and The United Kingdom of Great Britain and Northern Ireland), four experts selected on thematic issues (fire risk, space-based information, data interoperability, and disaster risk management), as well as two young scientists.

The objective of the E-STAG is to tackle emerging challenges in DRR, focusing in particular on improving risk knowledge in 55 countries across Europe and Central Asia.
The E-STAG experts aim to contribute to a research informed and evidence-based implementation of the Sendai Framework, especially in assessing gaps and challenges for formulating recommendations. In this context, the work of the E-STAG is designed to support national and local authorities, policy & decision makers in priority, but also private investors and other relevant DRR stakeholders.

The United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Europe serves as the secretariat and coordination entity of the E-STAG.
The E-STAG takes part of the global partnership efforts initiated by UNDRR, in particular the Science & Technology Roadmap and the Global Science & Technology Advisory Group.

For more information about E-STAG, please contact:

United Nations Office for Disaster Risk Reduction - Europe
37 Bvd du Régent – 1000 Brussels
E-mail: estag@cc.preventionweb.net
Website: www.undrr.org

1 Executive Summary

Disaster risk reduction (DRR) involves complex processes with different stakeholders at all administrative levels. Two elements in particular play a major role: the need to ensure stakeholders interoperability through an efficient exchange of **data**, and the inclusion of **socioeconomic factors** which may influence disaster risk reduction processes. This report aims at contributing to increase the global knowledge on these two elements, focusing on the related issues affecting disaster risk reduction throughout the European continent. The information contained in this report would support national authorities and DRR stakeholders in the continued implementation of the Sendai Framework, and to address the specificities identified by the EFDRR Road Map.*

Based on national briefs, surveys and interviews, the report stresses the following recommendations for public authorities and relevant stakeholders:

At the regional/national level

- Increase attention to demographical issues, in particular the growing elderly population and the refugees and migrants.
- Plan sufficient funding for adaptation to climate-change related risks, in particular rising sea-level and extreme weather events such as heatwaves.
- Increase stakeholder awareness about barriers which prevent the effective use and exchange of data to support DRR.
- Raise awareness on the importance of high quality, availability and trustworthiness of disaster relevant data.

At the national/local level

- Nurture political engagement for DRR.
- Secure the appropriate funding for Sendai Framework implementation.
- Systematically "tag" DRR investments in national and local budget plans.
- Acknowledge and make explicit the connection between socioeconomic factors, vulnerability, and DRR.
- Promote the creation of standards, standardized methods and technologies for collecting disaster related data.
- Promote and support the creation of national disaster loss databases aligned with Sendai Framework indicators.

At the local level

- Build capacity, particularly by improving the general DRR-competence and by focusing on prevention measures and activities.
- Increase engagement and knowledge of actors by providing methodologies and structures for data interoperability.

*European Forum for Disaster Risk Reduction Road Map

2 Introduction

The social landscape throughout Europe displays huge differences in politics, economy, welfare, integration, and other social factors. Similarly, the threats levelled against the continent vary in both nature and magnitude. The strategic and operative decisions in the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 [1] must be based on comprehensive and correct information that reflect these variations. The data that support the decisions need to be obtainable, reliable and complete. Alas, today we are far from these goals. If we can identify and better understand the barriers in the supply, integration and comprehensive use of data, we can improve the knowledgebase for science-informed decisions in disaster risk reduction (DRR).

Data per se does not solve the appropriate implementation of the Sendai Framework. Improving the DRR-capacity of European countries as well as the continent as a whole necessitates to be aware of the risks that European countries face and the contextual challenges to meet them. Adapting the implementation to the country-specific socioeconomic conditions is therefore crucial. While each state is responsible for its own DRR strategy, the European community is a salient convergence for knowledge exchange, agreements, and collaboration. The support for countries with the appropriate tools and guidelines can be improved if they are based on deep, empirically grounded knowledge. In this respect, **the ultimate goal is to have access to data that are both reliable and sufficient and that is adapted to the specific social realities of different countries. This report is a step in this direction.**

After a brief introduction of the topics below, the remainder of this report first presents the key findings of the empirical studies that the E-STAG has conducted thus far and then provides some conclusions and way forward.

Sendai Framework Monitor (UNDRR)

The significance of socioeconomic factors for disaster risk reduction

This report aims to contribute to raise the awareness of socioeconomic factors that have the potential to strengthen or undermine DRR efforts, with the aim to better integrate these socioeconomic factors in DRR activities at different administrative levels throughout Europe.

A disaster occurs when a significant number of people experience a hazard and suffer severe damage, losses and/or disruption of their livelihood system in such a way that recovery is unlikely with own resources and possibly without external aid. **A disaster can be thus viewed as a social phenomenon occurring when a hazard meets the social world with severe and negative impact.** This interaction between hazards and the social world is usually what in the social sciences literature is referred to as disaster risk. Analytically then, we can isolate two major components of disaster risk: the hazard component and the vulnerability component – both of which can be subject to risk reduction activities. Hazard and vulnerability are not exclusive or independent parameters. Many typical environmental phenomena are made to be hazardous through vulnerability creation. For example, structural flood management approaches tend to encourage settlement in floodplains without flood risk reduction measures. Vulnerability to floods is thus created through increased exposure alongside a usual, cyclical flood becoming a hazard.

Vulnerability may be understood as a potential loss and is defined here as a product of individual and collective social capacities and resources. In the disaster literature, common typologies of resources that should be taken into consideration for DRR are:

- Economic resources – e.g. finance, markets, incomes and payment system, which affect how much accessible money exists to cope with crises/losses.

- Social resources – e.g. social integration, real and virtual networks, which affect the level of solidarity.

[1] *https://www.unisdr.org/we/inform/publications/43291*

- Human resources – e.g. local knowledge, health care, skills, experience and education, which affect strength, endurance, knowledge and skills to face hazards.

- Political resources – e.g. flexibility, representation, leadership, participation and legitimate institutions, which affect the power and ability to make sound decisions.

- Physical resources – e.g. infrastructures, buildings, homes and shelter areas, which affect safe and well-functioning housing and business.

- Natural resources – e.g. hazard resistant crops, arable land, biodiversity resources and safe water, which affect how people endure after social rupture.

The level of and accessibility to resources is contingent on how people make use of resources and make decisions concerning them. These resource-related actions and structures are the actual drivers of vulnerability and, in a more radical sense, are the true causes of disasters. For these reasons, it is important to study resource-related actions as well as the social and institutional structures influencing them in order to understand how they may (a) have potentially negative effects on the state of the social system and on DRR, and (b) may amplify existing vulnerabilities and possibly create new ones.

The tangible earth (UNDRR)

The significance of data for disaster risk reduction

This report aims to contribute to the advancement of data interoperability, which has the potential to improve the effectiveness and appropriateness of DRR actions. Data interoperability is presumably a key factor to better understand how to minimize the impact on populations and assets from hazards.

The International Council of Science and the Committee on Data for Science and Technology [2] highlights the profound opportunities digital technology offers to science to discover unsuspected patterns and relationships in nature and society, from local health systems to global sustainability. A holistic understanding of the complex challenges confronting humanity can be better reached through interdisciplinary approaches and by the integration of data across relevant communities. However, a barrier to the achievement and exploitation of this potential arises from the incompatible data standards and nomenclatures used in different disciplines, by different data owning organizations, and on different administrative levels. Although the problem has been addressed by several initiatives, the challenge to make digital data integration a routine still remains.

The lack of data interoperability significantly affects planning, implementing, and assessing DRR. **The exchange of information between scientists, policy and decisions makers, stakeholders, practitioners, and citizens needs to be efficient throughout the whole disaster cycle.** A shared understanding of risks and a systematic inclusion of disaster risk in science-informed policies, strategic decisions and in investments can also improve the efficiency in activities related to the management and response of emergencies.

In this context, citizens are also a strong resource for data collection, considering that the growing amount of open data made publicly available represents a strong potential to support DRR strategies. This potential should be properly catalysed and valorised.

[2] *https://www.codata.org*

Challenges in implementing the Sendai Framework for Disaster Risk Reduction 2015–2030

The E-STAG has studied the above socioeconomic and data issues empirically from May 2018 to February 2019. The report is based on three sources of information from the studies, focusing on overall disaster risk management in Europe, socioeconomic factors, and data management.

First, experts used national briefs about DRR context, challenges and opportunities developed by their national counterparts. These briefs particularly underscored existing legislation, governance mechanisms and the inclusion of different stakeholders in platforms and decision-making processes. As a second source of information, a subgroup of the E-STAG experts focused on disaster loss data, data collection processes and use of available information. A survey was completed by 65 scientists, data specialists and DRR stakeholders engaged in data production or use. Experts consolidated and analysed data against the Sendai Framework set of indicators. Finally, the E-STAG experts conducted interviews with National Disaster Risk Reduction Focal Points in 10 of the 55 European countries covered by the UNDRR Regional Office for Europe.

This chapter presents the results and key findings from the studies.The elements in the report are based (non-exhaustively) on information referring to the following list of Member States: Armenia, Austria, Belarus, Belgium, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Israel, Kyrgyz Republic, Luxembourg, Montenegro, The Netherlands, North Macedonia, Norway, Portugal Russian Federation, Slovenia, Spain, Sweden, Tajikistan and the United Kingdom.

3 Socioeconomic Challenges

Understanding Risks

1. Connecting National Risk Assessments and socioeconomic factors

In most European countries the relevant governmental agencies regularly conduct National Disaster Risk Assessments*(NDRA, or sometimes just National Risk Assessments). The assessments identify and report potential risks that the country may face in the present and in future, and are the base to determine country capacities and future investments. The NDRA is usually carried out by a group of experts coordinated by a responsible entity (such as in Italy, Sweden and the United Kingdom), by different ministries (Slovenia), or by a set of national institutions from different sectors conforming a bigger group such as The Network of Analysis for National Security [3] in The Netherlands. Currently, a large number of countries make their NDRA publicly available. The period between publications (generally every four or five years) and the number of risks analysed (26 in the United Kingdom, 27 in Sweden or 45 in The Netherlands) is an individual decision of the country. Risk analysis are often based on the likelihood of the event and impact (scale and degree of disruption) for different scenarios. Meanwhile, uncertainty on the outcomes is not always analysed in deep. Norway experts use the so-called Barrier and Bow Tie Model [4] for risk analyses built on event-based data.

The last global guidelines [5] for the development of NDRA was edited by UNDRR under the initiative "Words into Action" in 2017.The same year, the OECD did a comprehensive evaluation [6] of the current state and methodology of NDRAs in twenty countries. The evaluation identified that not all stakeholders, especially at the local level, are aware of the Sendai Framework and that some countries lack local competences. These points are in line with the findings in this study, which indicate a need to improve the competence and the political dedication on local level in order to influence an increased allocation of subsequent funding for DRR measures.

A main problem with risk assessments identified in the study is that they are usually not connected to socioeconomic factors and drivers of social vulnerability. If risk assessments explicitly address how economic and political decisions can either strengthen or

[3] https://www.preventionweb.net/files/Network of Analysts.pdf
[4] https://www.norclub.com/services/loss-prevention/the-barrier-and-bow-tie-model
* Risk assessment is a requirement in EU countries as set out in Article 6 of the European Union's Civil Protection Mechanism (Decision 2019/420 amending Decision 1313/2013)
[5] https://www.unisdr.org/we/inform/publications/52828
[6] https://read.oecd-ilibrary.org/governance/national-risk-assessments_9789264287532-en#page1

undermine DRR the latter can potentially move from being a technical issue to take a place on the political agenda. This, in turn, can lead to an improved allocation of funds to DRR.

Most countries present analyses at municipal level. Russia has regional and municipal-level risk maps which bring territorial data with relevant emergency scenarios, vulnerabilities and resilience are assessed also at regional and local levels. Croatia has regional risk assessments and multi-hazard risk distribution maps. The Croatian Ministry of Finance uses its own database for natural disaster losses and a system for local level damage assessment and recovery financing. In some cases, the database is neither public, nor sufficient for national disaster risk and vulnerability assessment, as it lacks information on human losses, vulnerability, and critical infrastructure. In Slovenia, in the case of earthquakes, the law of 1998 that enforced to manage response and reconstruction of large and regional events is an example of good practice for combining the reconstruction, building back and spatial development on local level.

Overall, the analysis of assessments and its related processes identified a need to improve inclusion of climate change risks,* related to a weak use of geo-data at local level, posing a risk of tunnel vision.

As risk assessments rely on formal procedures and are elaborated every few years there is a need for strengthening connections with innovations in research and technology. Risk assessments should be updated with the latest methods and data available, including satellite data which enable standardized spatial view across national borders.

National and regional risk assessments require a legal framework and financial resources. The approaches to funding vary across Europe. In countries where funding is not a problem, such as northern Europe, sometimes the political will or the prioritisation of national projects can mean that the real investment for DRR is reduced. Other European Countries found economic resources as a main barrier to properly assess the risks to which the country is exposed. Nevertheless, recent progresses should be underlined, for example in Slovenia and Montenegro. Both countries acknowledge how the allocation of budgets is evolving positively thanks to the efforts done at National and European levels with the development of new strategies for DRR. The most repeated concern in the European countries is the lack of standardisation of funding and implementation of DRR assessments locally, where the economic resources are more limited.

In the elaboration of the assessments, most of the Northern-European countries interviewed show good levels of inclusion of the private sector and civil stakeholders. South Eastern countries see a need to improve the inclusion of private companies. In general, public and private partnership and public participation should be strengthened. It is important though to involve not just more actors but also different kinds of stakeholders in risk assessments. In particular, more effort is necessary to involve actors from the social services, and representatives of different NGOs, to complement the technical side and potentially lead to more holistic risk assessments.

In Norway and France, stakeholders and the general public are to a high degree involved in DRR consultations at regional and local levels, as required by law. This good practice remains quite exceptional across Europe.

Croatia provides also useful examples in specifically including contributions from the academic community. This type of collaboration which exists in other European countries is a key factor for better inclusion of relevant stakeholders in risk knowledge efforts and decision-making mechanisms. In this regard, Sweden, Russia, Croatia, Slovenia and The Netherlands mention the inter-sectoral and inter-governmental collaboration as a relevant aspect to facilitate stakeholder participation. In other cases, national, county and local authorities work together on risk assessments and urban planning, as in France and Sweden. Some countries have inter-sectoral DRR boards, but the majority lack tight and guided cooperation between the sectors. However, though the inclusion of private sector is not complete,

* *Also highlighted in the European Commission Overview of the natural and man-made disaster risks that the EU may face: SWD 2017/176*

companies started to use outputs of risk analysis – for example, banks – for funding of DRR measures at local level.

2. Science for people-centred policies

In the use of science for policy and governmental support for DRR research, the United Kingdom has developed the National Hazard Partnership [7] to provide scientific advice in natural hazards and evaluate more sensitive data for the government, and the UK Alliance for Disaster Research [8] to promote the representation of the research community at governmental level. Italy maintains a long tradition of cooperation between the scientific community and the civil protection system. In 2004, several national research institutes and university consortia have been established as Centres of competence, forming a network to provide Civil Protection with services, information, data, and to share good practices in risk assessment and management [9].In some countries, there is scientific presence in platforms, advisory boards, and professional networks as well as through dedicated research funding programs. In other countries however, the scientific presence is more informal and most of the economic support for research comes from local communities and EU Projects, while the national funding is focused to the most representative risks. The Netherlands uses a pragmatic approach, where partnerships are established with other countries with similar geographical, social or climate characteristics. Examples are the partnership of the Netherlands Organisation for Scientific Research [10] in projects such as Communities and institutions for flood resilience [11] in which The Netherlands and Bangladesh, two deltas countries, enhance mutual learning in modifying and developing flood risk management policies; or the Netherlands US Water Crisis Research Centre [12], a comparative study about flood preparedness between The Netherlands and United States of America (Flood preparedness in The Netherlands a US perspective[13]).The Netherlands' approach helps the self-funding of scientific research centres such as Deltares [14], at the same time that knowledge and capacity building is transferred to other countries.

Due to the cascading effects of disasters and the increasingly open global trading system, disasters across the world can affect the European continent. To face this global issue, The Netherlands and the United Kingdom are taking actions by the promotion of funded initiatives in developing countries outside Europe, such as the Global Challenges Research Fund [15] and the Partners for Resilience [16].

Scientific research in European countries is broadly used to generate assessments that are the base for policy making. However, with the exception of United Kingdom, **the structure of having a Chief Scientific Adviser for policy making is absent**. New ideas are starting at European level, such as the European CSA [17] network formed by scientific advisers from The Netherlands, Spain, Portugal to advise in common European questions, but with the objective to have linkage at the national level. The European CSA network is still not completely formed and would benefit from more investments and a legislation about its roles at European level.

In general, there is a lack of communication of the extensive scientific knowledge to the regional and local levels, and its sharing among the countries, especially the neighbours. This challenge also concerns new and emerging risks and social perspectives of DRR affecting the understanding of long-term risks and causing poor and improper (risk) management practices.

Other initiatives include the Oasis Loss Modelling Framework, a public private initiative aiming to improve risk assessments. Oasis Loss Modelling Framework provides a free open source platform for developing, deploying and executing catastrophe models while also nurture collaboration and strengthening links between the scientific community and businesses.

[7] http://www.naturalhazardspartnership.org.uk
[8] http://www.ukadr.org/
[9] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC104362/science%20for%20policy%20report%20%233_final-online%20version.pdf
[10] https://www.nwo.nl/en
[11] https://www.nwo.nl/en/research-and-results/research-projects/i/16/7316.html
[12] https://publicwiki.deltares.nl/display/NUWCREN/Netherlands+US+Water+Crisis+Research+Network
[13] https://www.preventionweb.net/files/30381_nuwcren2012floodpreparednessinthene.pdf
[14] https://www.deltares.nl/en/
[15] https://www.ukri.org/research/global-challenges-research-fund/
[16] https://partnersforresilience.nl/en/
[17] https://www.euroscientist.com/european-countries-need-chief-scientific-adviser/

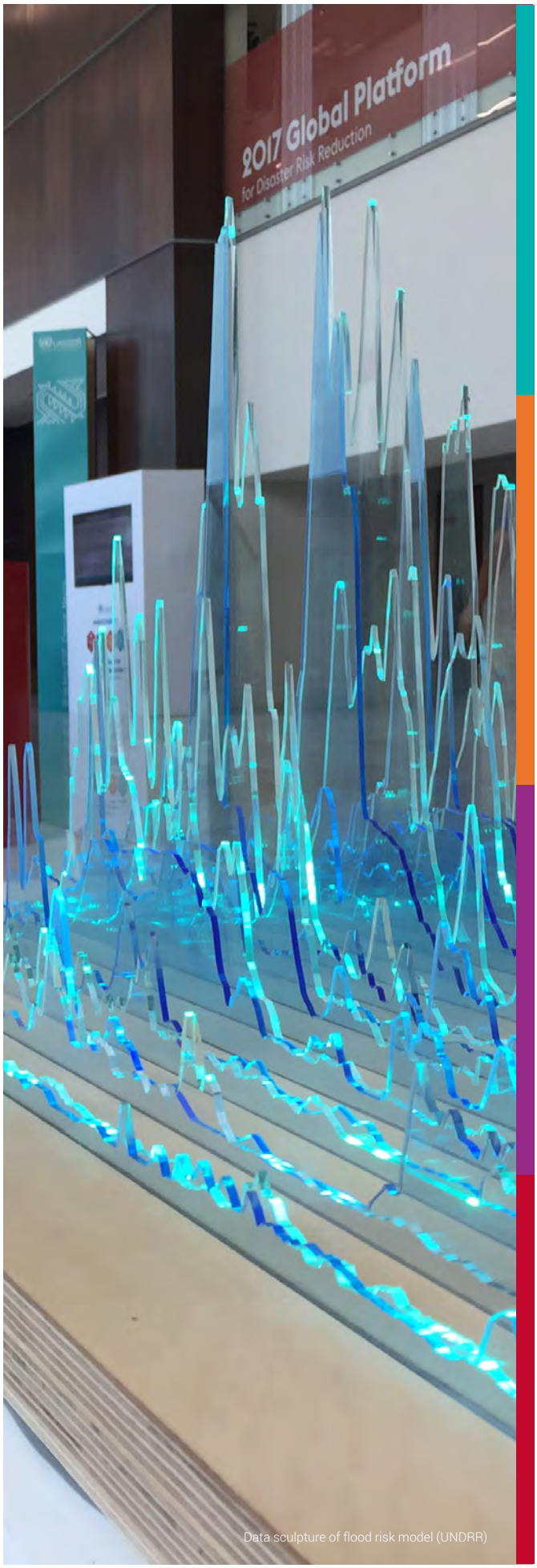
Strengthening disaster risk governance

The terminology agreed by Member States for the Sendai Framework defines disaster risk governance as the "system of institutions, mechanisms, policy and legal frameworks and other arrangements to guide, coordinate and oversee DRR and related areas of policy [18] ". Some of the characteristics of good governance in disaster risk refer to the need to be "transparent, inclusive, collective and efficient to reduce existing disaster risks and avoid creating new ones". Disaster risk governance at the local, national, regional and global levels is thus of great importance for an effective and efficient management of disaster risk in its socioeconomic dimension. Clear vision, plans, competence, guidance and coordination within and across sectors, as well as active participation of relevant stakeholders, are essential elements for effective prevention, mitigation, preparedness, response, recovery and rehabilitation.

The governing bodies on all administrative levels need to put more focus on DRR (rather than solely working with response/preparedness). This would mean a more comprehensive appreciation of risks, including risks related to sustainable development, national and international security in a broad sense, climate change, environment, economics and conflict.

It is essential to integrate risk governance with the already established processes in public administration. Disaster risk governance should not be yet another silo operating isolated from other areas of societal importance. By integrating disaster risk governance with regular work processes, such as the sustainable development goals and climate change adaptation, more efforts can be put on the preventive measures of DRR.

A shift from re-active to pro-active focus necessitates the involvement of more actors and representation from the local communities. This, in turn, make way for a people-centred approach with adaptation to specific local socioeconomic conditions.



Data sculpture of flood risk model (UNDRR)

[18] *Report of the Open-Ended Intergovernmental Expert Working Group on DRR terminology and indicators*

1. Multi-stakeholder participation

The importance of stakeholder involvement is widely recognized and considered essential to disaster governance. UNDRR published guidelines for the establishment of national platforms [19] for DRR to serve as "advocates of DRR" and "provide coordination, analysis and advice on areas of priority requiring concerted action through a coordinated and participatory process". As a good example, The United Kingdom addresses this priority through the delivery of a framework for directing and facilitating emergency planning, by namely the Civil Contingencies Act 2004. [20] An emergency response and recovery [21] guideline complements the act by establishing a framework for emergency response and recovery between multiple agencies.

At local level, in the case of Greater Manchester (UK), the same objective is all about engaging, collaborating and working across boundaries. This applies to all policies, including those concerned with resilience. The development and implementation of effective multi-stakeholder disaster risk governance has been an iterative process building steadily over a decade of partnership and collaboration.

Despite the existence of good practices in some of the countries studied, the call of the Sendai Framework for people centred DRR approaches, and inclusive DRR governance mechanisms involving the civil society still needs to permeate across European countries.

2. Collaboration and coordination

The second characteristic is collaboration at various scales. For example, the distribution of government functions (e.g., administrative, managerial, regulatory) across state and non-state actors facilitate vertical and horizontal disaster risk management and supports local capacities, establishes trust, and enhances cooperation. Several countries have developed and maintain National Platforms for DRR, based on national priorities and administrative structures. Among its assigned tasks, a national platform aims to facilitate the collaboration and coordination to define sustainable activities of DRR following a process of consultation and participation, and by integrating these activities in the national policies of development.

In Slovenia, the risk governance system is divided into the national, regional and local levels, and supported by the State and municipalities. However, the conceptual framework implies shared responsibility of official structures and citizens. Accordingly, every individual should also be responsible for their own safety. Protection against disasters is considered a subsystem of the national security system and therefore organizationally belongs to the Ministry of Defence. In this way, it is coordinated and linked with other national security subsystems, and to municipalities where DRR is the responsibility of the mayors.

In some cases, emergency management systems face a lack of horizontal links, e.g. coordination with other sectors, such as space, health and education. The inclusion of civil society is also a challenge frequently reported by stakeholders.

3. Local level involvement

Local governments often serve as first responders, responsible for continuous community development and sustainable DRR. The empowerment of local governments should be a key priority in order to encourage democratic decision-making and implementation that involves citizens and stakeholders from the governmental, private and non-profit sector at the local level. DRR at the local level depends on good local governance, particularly in political decision-making, formulation of

[19] *https://preventionweb.net/*
[20] *https://www.legislation.gov.uk/ukpga/2004/36/contents*
[21] *https://www.gov.uk/guidance/emergency-response-and-recovery*

policy, and enforcement relating to land-use planning, regulatory controls, zoning, and construction standards. Accordingly, a full understanding of disaster risk governance at local level needs a thorough understanding of the role of the various actors and sectors and how they operate. Achieving local "ownership" for disaster risk governance depends on many factors, including interactions between communities and local actors in charge of implementing DRR policies. There are strong indications that many failings exist in attempts to practice decentralized disaster risk management at local government and community levels (Aysan & Lavell 2015).

There is a need for context-specific risk governance arrangements to promote DRR at the local level. It is also important to identify how socioeconomic challenges faced by local governments can influence the successful implementation of DRR initiatives. The importance of good governance in DRR is well understood across Europe, but how good governance could be substantially engaged at local levels to promote DRR practices has not been yet clearly addressed.

In offering guidance on how to translate the Sendai Framework into an ongoing and effective action on the ground, UNDRR suggests local platforms of diverse stakeholders be established. These can support city governments in consultation and consensus building, as well as local policy formulation, regulation, implementation and enforcement activity. The following four key-principles of DRR governance have been developed from the results of the survey:

- **Equity** of access to decision-making processes should be considered as one of the basic necessities of community life. The sharing of power leads to equity in the access to and use of resources. Women and men must participate as equals in all community and urban decision-making, priority-setting and resource allocation processes. Local governments should consistently provide everyone equitable access to basic services, to disaster risk information and DRR measures.

- **Flexibility** is a major characteristic. The creation of ad-hoc groups and networks, community self-organization, or the adjustment of policies, regulations, etc. are widely perceived as essential and important components of disaster risk governance. Conclusions on the beneficial effects of flexible governance structures are largely drawn from disaster response and recovery experiences. Very little is known about flexibility, learning and innovation in a governance system to generate and implement transformative, systemic changes that reduce disaster risk or adapt to climate change over the long run.

- **Consensus:** In the Netherlands, brought here as good example to present consensus, flood risk management plans at sub-basin level for the Rhine, Meuse, Scheldt and Ems rivers were open for public review, reinforcing risk governance at all levels. Nowadays, the cooperation of water managers and emergency managers within the Steering Group of Flooding is close in each safety region. The traditional Dutch flood risk governance has been technical and the water managers are legally seen as responsible in case of disaster. Legal standards are still in favour of flood defences based on cost-effectiveness studies and resource efficiency. All flood defences are based on tax solidarity excluding people living outside the defences. People not living in flood protected areas do not take part of this tax solidarity and do not receive any compensation. They are therefore more exposed and characterized by higher vulnerability. Despite the drawbacks, flood risk governance in The Netherlands has shown to be well accepted by the population and open to public participation by formally published drafts and exchange of information.

- **Accountability and transparency** are ways of ensuring adherence to a set of common principles, values and objectives. If those in positions of power and authority take responsibility for their actions and inactions, and certain unambiguous sanctions follow in the case of neglect of responsibility, it is easier to ensure responsible decision making. The outcome of disaster risk governance depends to a large degree on the extent to which various stakeholders can be held accountable for their actions and inactions.

Investing in Disaster Risk Reduction

The Sendai Framework stresses the importance of public and private investments in structural and non-structural measures to enhance the social, economic, health and cultural resilience of persons and communities.

Even if several resilience policy frameworks include early warning, preparedness and prevention, the overall preparedness is commonly run and financed by civil defence organisations and emergency response services, with prevention measures receiving less attention as a defined policy agenda and role.

In specific contexts and for particular hazards, considerable emphasis is placed on land-use planning and water management, arguably prioritizing risk reduction and hazard mitigation above preparedness for response and recovery.

In other cases, the variation of ear-marked DRR allocations in national budgets are large. Several countries don't appear to have a specific budget line for DRR, and when DRR is specified it is not always systematic and sustainably continued. At the same time, some DRR investments, such as watercourse regulation or infrastructures are not labelled DRR in budget plans.

Accounting for disaster risk reduction is challenging because much is not routinely led by disaster management authorities, but rather mainstreamed into the regulations and practice of agencies responsible for everyday land-use, social policy or environmental regulations and norms. The action of local communities and private businesses to strengthen local economies and enhance social cohesion, that in turn reduce vulnerability and raise capacity for resilience, are also difficult to isolate from ongoing development initiatives and so have not been included in national accounting. This is a major lacuna for tracking progress about DRR investments in line with the Sendai Framework.

Resilience and related investments are implemented through multiple-levels of government. National actors access strategic budgets, provide policy oversight, are a guarantor of national security and of access to risk information, for example through national risk maps and early warning systems. One good principle of investments is disaster risk management in collaboration. It is the case in Sweden, where the Civil Contingencies Agency rolled out a policy in 2017 on common grounds for collaboration and leadership. This policy is implemented at all administrative levels. Other examples of multi-level governance bring national, regional and local government capacities together in six so called Collaboration Areas. While technical capacities are generally very good, the complexity of these systems can generate bureaucratic inefficiencies.

Administrative and budgeting arrangements reflect degrees of national political decentralisation. This is demonstrated in Italy, where national budget laws and other primary norms represent the legal basis for the assignment of the funds aimed at the risk prevention, mitigation and reduction. These funds are subdivided by region following indicators such as population, area and hazard exposure. Subsequent interventions are agreed collaboratively by the State and

Regional authorities (Municipalities, Regions, Ministry of the Environment, Civil Protection Department), allowing these agencies to be part of review and programming for budgets and to implement programmes, projects and monitoring activities aimed at prevention and forecasting. There is often a joint participation of local institutions, which add funds to the budget allocated by the State.

The judgements on the monetary needs of investments in resilience building for seismic risks in Italy is determined by the National Plan for Seismic Risk Prevention. In this case, the methodology establishes a budget based on the calculation of a "minimum standard to program interventions on risk reduction for civil protection purposes". These standards are defined by the Civil Protection Department, the Agency for the Territorial Cohesion and other competent bodies.

The private sector is increasingly involved in resilience building, especially the construction and insurance industries. Italy has developed good practices in this sector, with two public-private partnerships for seismic risk mitigation. One provides for private owners to receive tax deductions if they agree to co-finance costs of improved physical resilience to buildings. Another initiative is the Piano Casa programme which can allow real estate owners an increment part of a building's volume for seismic retrofitting.

Similar potential for investments in partnering with the insurance industry is illustrated in the UK's Flood Re Temporary Scheme [22]. The scheme hopes to facilitate access to affordable flood insurance for half a million households in high flood risk areas by providing a reinsurance facility. To achieve this Flood Re raises GBP180 M every year through a levy on insurers, which Flood Re then uses to cover property losses in case of a flood. France is also an example of good practice with the implementation of a specific fund taken from insurance premium, around 12% of invoices. The EUR200 M raised every year contribute partly to DRR measures and partly to reconstruction and post-disaster activities. Economic repercussions of disaster risks can be also attenuated by well-designed ex-ante financial management and protection instruments. A sound financial protection strategy can lessen these impacts, speed up recovery and reconstruction, and harness knowledge and incentives for reducing risk. Increasingly interconnected world disasters can have far-reaching, spill-over effects. An optimal strategy builds upon a diversified pool of mutually complementing financial tools and institutions is better equipped to cope with and respond to a variety of risks. The contingent losses from frequent, low-impact risk can either be reduced or retained through adequate funds in form of savings, set-aside reserves or credits. Medium to high level risk exceeding the risk-bearing capacity can be more efficiently managed by risk transfer via insurance or capital markets.

In the United Kingdom, the so called Bellwin scheme [23] offers emergency financial assistance to local authorities, and provides funding designed to recompense local authorities for the costs of emergency measures undertaken to safeguard life or property, or to prevent further suffering and inconvenience locally, during exceptional circumstances.

However, there is a specific need to concentrate funding on pro-active and prevention measures aiming at building resilience. Despite good results, the project-based or short-term partnership approach of DRR requires to be strengthened by long-term sustainable and structural investment plans.

[22] *https://www.floodre.co.uk/wp-content/uploads/2018/07/Flood_Transition2018_AW.pdf*

[23] *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/653402/Bellwin_Scheme_Guidance_Notes_2017-18.pdf*

Enhancing disaster preparedness

A key priority of the Sendai Framework is to increase the preparedness-efforts for population groups with either particular individual vulnerability or who are living under structural conditions that makes them particularly vulnerable. This includes a combination of awareness among persons in decision-making positions and the empowering of the conditioned people to publicly lead and promote gender equitable and universally accessible response, recovery, rehabilitation and reconstruction approaches.

The approaches adopted by European countries is predominantly reactive regardless of economic development, although there are some well-established proactive policies and a number of countries where a more integrated policy is being implemented. The key driver for this weakness is the lack of incentives for prevention and DRR as well as a weak awareness of the benefits in the mid- and long-term, and a societal choice for disaster cost-sharing through insurance and self-protection.

1.Coordination

The surveys showed differences in approaches to governance between countries that have rarely suffered from disasters, and see no need to change their systems, and others that are more disaster-prone but lack resources to make the necessary improvements.

An additional challenge for countries is how to integrate Sendai Framework priorities into long-established national cultures of disaster management. Countries call for more guidance on how to implement the Sendai Framework at national and local level.

Disaster preparedness and contingency policies can reduce the disaster impacts and speed up the recovery processes. Italy includes good practices in terms of preparedness, with its network of multi-risk surveillance and early warning centres established by the Civil Protection Department, and supported by the regions and autonomous provinces which provide critical and timely information for disaster response operation.

Sendai Framework Priority 4 calls for pre-event planning and coordination mechanisms for post-event recovery, and better understanding of functional requirements and resource needs. Different approaches remain in use, as in the United Kingdom, the Scientific Advisory Group for Emergencies [24] is activated during emergencies, whereas in Italy the Major Risks National Commission helps to improve risk assessment, forecast and prevention of risks.

Previous disasters offer costly but valuable lessons. These lessons need to be understood and translated into tangible advances of risk governance.

A systematic aftermath review of the damaging events is rarely conducted or not in a sufficient depth. The review has to provide insights into economic costs and social hardship suffered from the disaster, taking into account the direct, indirect and intangible damage to economic sectors, (critical) infrastructure, human health, community well-being, and environment.

The knowledge of the full social costs of a disaster is fundamental for efficient recovery aid and assistance. In this regard, in Sweden, preparedness plans have evolved using the lessons learned from past events concluding that authorities at different levels can sign agreements with NGO's so they can help during an emergency. Hereby in accordance with Priority 4 the existing disaster preparedness plans are strengthened and response capacities increased by using the relevant non-governmental stakeholders.

[24] *https://www.gov.uk/government/groups/scientific-advisory-group-for-emergencies-sage*

Also important is the continuity of operations and planning in the post-disaster phase, including social and economic recovery, and the provision of basic services. As examples, Swedish and Croatian governments ensure continuity of services through decentralization of operations. Municipalities are responsible for taking care of victims after an emergency.

In Slovenia, the state government provides reconstruction funds to communities when economic loss exceeds 0.3% GDP. Italy uses a different approach where reconstruction costs are refunded by the State during national emergencies, including build back better additional costs. The European Solidarity Fund [25] provides immediate financial assistance to disaster-stricken member states and regions. Similarly, in Norway, Norwegian Natural Perils Pool [26] and private insurance cover the economic damage, and in case a damaged house that originally was located in a high-risk area has to be rebuilt, the cost of rebuilding elsewhere is covered.

A part of the priority 4 of the Sendai Framework is to strengthen the capacity of local authorities to evacuate persons living in disaster-prone areas. To achieve this goal, the capacity and readiness of administrative bodies and residents in local communities need to be improved. **As good examples, Croatia and Norway have setup a legal framework empowering the administrative bodies to coordinate, manage and empower local actors to help execute the evacuation of endangered persons.** The legislative framework is an important tool to set the learned lessons from past disasters into use on daily basis, including resilience of new and existing critical infrastructure. Here spatial planning widened with local knowledge and past disaster learned lessons plays an important role. **Therefore, the question to what extent local residents from different groups (ethnicities, gender, ages, ethnic, special interest groups) are involved in spatial planning processes and in investment projects that might change the current risk-landscape is important when monitoring the countries disaster risk preparedness.** Therefore, spatial planning processes should be open and transparent. Residents should receive information about spatial planning endeavours including all ethnicities, men and women, different age groups, and special interest groups. This component is particularly implemented in France and can be seen as a good practice to be replicated.

2. Awareness and Training

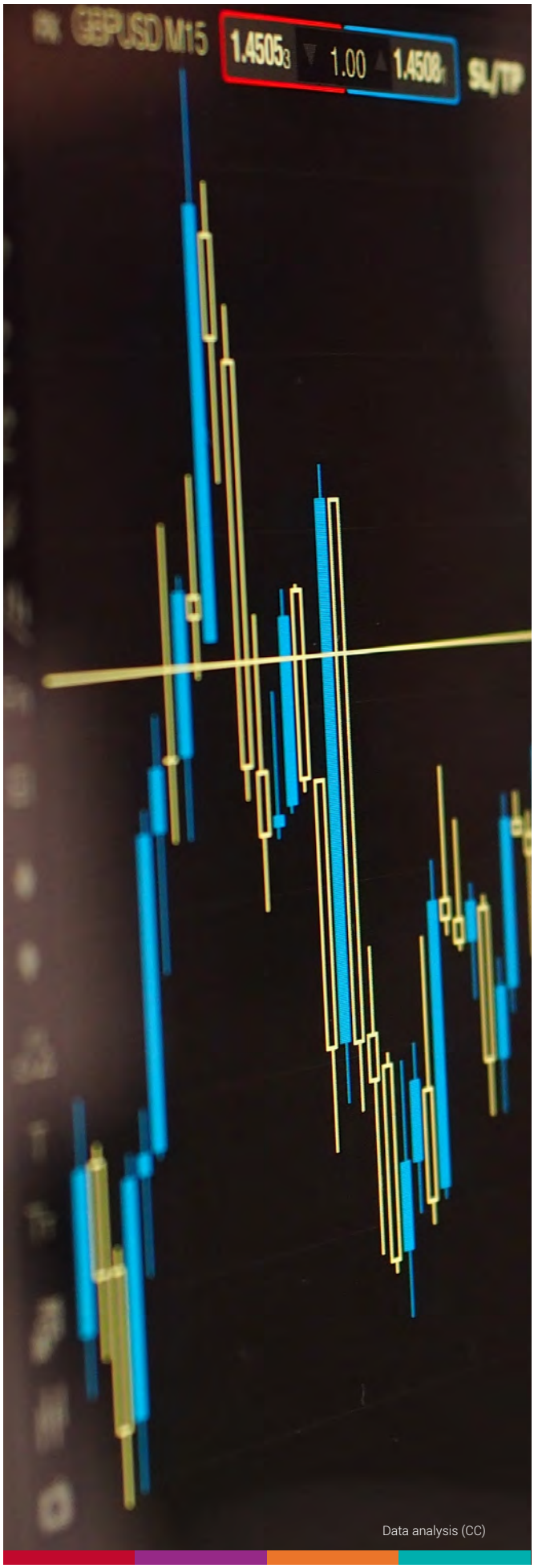
Efficient and inclusive preparedness efforts include promotion of public awareness and the stockpiling of necessary materials to implement rescue and relief activities. Promoting public awareness can be done through books, leaflets, social media and other media, as developed by Italy (iononrischio) [27] , or through formal education such as the project "On the road to disaster risk reduction" [28] which is intended to do the first step towards educating students from kindergartens to university students in disaster risks.

Outcomes of risk assessments are publicly available by traditional reports, brochures or by ICT applications. **An example of good practice is the nationwide emergency alert system NL-Alert [29] in the Netherlands, which uses geospatial information to inform people exposed to any type of risk by cell phone.** This kind of alert systems and apps are in line with Sendai Framework recommendations. Ensuring preparedness and resilient communities require long-term educational campaigns. As good examples, several countries strengthened resources in this regard, with campaigns of individual awareness. However, there is a lack of inclusion of disaster risk matters as a mandatory subject in institutional education. Large differences exist about the inclusion of DRR topics in secondary education between the European countries and

[25] *https://ec.europa.eu/regional_policy/en/funding/solidarity-fund/*
[26] *https://www.naturskade.no/en/*
[27] *http://iononrischio.protezionecivile.it/en/homepage/*
[28] *https://www.climatecentre.org/resources-games/games*
[29] *https://crisis.nl/nl-alert*

regions (Komac et al. 2010). DRR is taught at different universities but a small number of them present focused education of risk managers or similar professions. Despite the educational campaigns, populations shows a low level of risk awareness and a high level of trust in government actions (Risico en Crisisbarometer 2018 [30]).

In case of education and training of volunteers, good practices are presented in The Netherlands and Slovenia where institutions in charge of disaster response are made up of highly prepared volunteers, as well as in Italy, where more than one million of volunteers belonging to local and national NGO's support local and national governments in emergency management. In The Netherlands, the Fire Brigade is composed by 70% to 80% of volunteers (Kuipers et al. 2014), and in Slovenia, the Education Centre of URSZR [31] supports up to thirteen regional centres dedicated to rescue plans and training. In several European countries policies have been taken to identify society functions, promote planning for the protection of critical infrastructure, local risk assessments and rescue. Protection plans have also been developed in order to better understand and use the existing capacities of the population.



Data analysis (CC)

[30] *https://www.nctv.nl/binaries/B2362%20NCTV%20Risico%20en%20Crisisbarometer%20voorjaar%202018%2003_tcm31-324866.pdf*
[31] *http://www.sos112.si/slo/page.php?src=iz12.htm*

4 Data Challenges

In adopting the Sendai Framework, the UN member states committed to systematic and cyclical measurement, monitoring and reporting of progress in achieving the objectives of the framework, in order to have a global overview of disaster trends, and gaps. Progresses are to be measured against seven global targets and associated indicators, which depends on the availability and quality of different datasets.

Obtaining these data requires stable processes in a number of steps. First, data must be selected, delineating the type of action to be performed and the data needed by different stakeholders. Second, data must be mapped, overviewing how and where the selected data can be acquired, identifying and taking notes of eventual restrictions and constraints. Third, data must be accessed, collected, and stored. Fourth, data must be assessed in terms of quality, to understand if they are complete, reliable, and compliant to the action purposes. Fifth, data must be prepared to be used, identifying and mitigating any potential barrier against data usability, such as languages, ontology, data model, type, and format. Finally, data must be shared, engaging the practical processes needed to support the delineated action, such as downloading, visualizing, making them readable /interoperable with eventual already existing software.

The United Nations Global Report on Disaster-Related Data for Sustainable Development [32], published in 2017, shows that there is a great heterogeneity in the availability of DRR relevant data. This heterogeneity is confirmed also at the European scale, as outlined in a report of the EC Joint Research Center. There are very clear differences between countries in terms of DRR relevant national structures, data availability and data quality. As a result European Commission services have developed the Risk Data Hub with the objective to improve access and share EU-wide curated risk data for fostering disaster risk management.

Data used for DRR in Europe originate from a wide range of sources, are of various spatial and temporal scales with likewise varying spatial and temporal resolutions and contains information about natural and social systems that dynamically interact in forming disaster risk as sub-components of hazard, vulnerability and exposure. Data for DRR can be long-term or short-term. Data used for long-term risk reduction include inputs to climate models for climate and sea rise projections, earthquake hazard analysis, vulnerability indices for scenario analysis, spatial planning, developement of seismic building codes, dimensioning of buildings and infrastructures near coastlines. Data used for short-term DRR include demographics, satellite observations and forecasted atmospheric variables for natural hazards early warning systems, with clear examples from pilot projects of forecast-based financing on how such systems provide windows of opportunity where early risk-reduction oriented actions can save lives and reduce economic impact. While no universal categorization of DRR data exists, the following categories are used in this report:

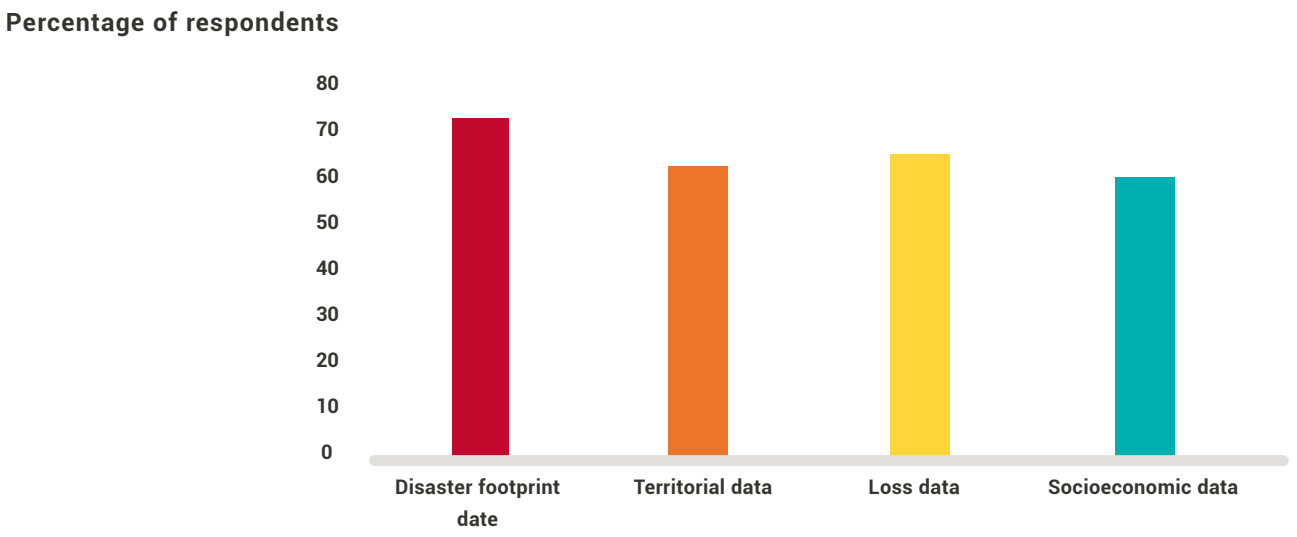
- Disaster footprint data: disaster type, hazard magnitude, affected areas
- Territorial data: geographically bounded data
- Loss data: disaster impact, often classified as tangible/ intangible and direct/ indirect respectively depending on whether the impacts are measured in monetary terms or not and whether the impact is primary or secondary (although direct, tangible impacts are most commonly addressed)
- Socioeconomic data: influences and contingencies that are rooted in social, economic, ideological, historical or political domains

[32] *https://www.unisdr.org/files/53080_entrybgpaperglobalsummaryreportdisa.pdf*

Using this categorization, 65 survey respondents with various roles as data users or data providers reported the relative importance of these data types as shown in Figure 1. As can be seen, disaster footprint data is more commonly used, followed by loss data. Territorial and socioeconomic data is reported by approximately the same percentage, although specific data embedded in these categories may vary significantly between relevant respondents.

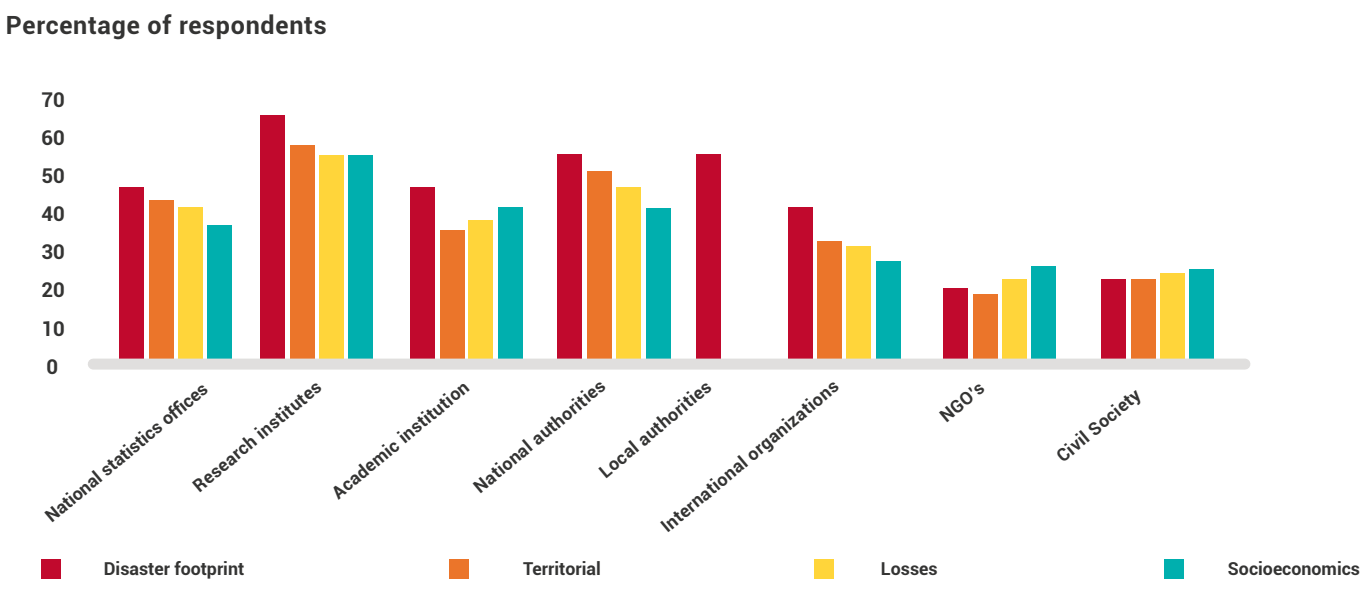
In addition to the four above-mentioned data types, other reported data types include: indirect, tangible damages, such as secondary costs related to insurance schemes, mental health and livelihood recovery, technical vulnerability indices, seismic data, institutional data, jurisdictional data and intangible direct and indirect data, such as casualties and injuries.

Figure 1: Percentage of data used for DRR actions (based on the feedback of 65 stakeholders).



The main data providers are presented below in Figure 2. The overall dominant role of research institutes in data dissemination have been identified, pointing to the potential of exploring collaboration and links between scientists and decision-makers to improve data interoperability for DRR-oriented actions.

Figure 2 Data providers filtered by data type.



For disaster risks with large spatial extents or potential to harm large areas, satellite data is particularly used with Geographical Information Systems (GIS). The reported data usage also reflects differences across local, regional (within national boundaries) and national scale. With increasing resolution of satellite products, land cover and land use has gained a central role in risk mapping. Particularly with respect to climate change impact studies for long-term informed decision-making and planning, data is needed to force climate models and other related models, such as hydrological or ecological models, and to project changes in vulnerability and exposure.

Lastly, an important note on the data used or deemed desirable for DRR in Europe is the weighting of DRR (e.g. enhancing resistance, resilience and preparedness before an event occurs) vs. emergency management and post-disaster recovery (e.g. relief and reconstruction). **A dominance of emergency management and post-disaster recovery is noted in several countries, inducing challenges for strengthening critical prevention measures.**

Data-related challenges in four domains

The integration of diverse data from globally distributed sources is crucial to improve societal resilience. The integration of data can improve our understanding of risks in new ways which in turn can support risk-informed policies, decisions and investments, and facilitate the implementation of efficient actions. These actions, called by the Sendai Framework, are carried out by public institutions at different administrative levels, NGO's, and the private sector. These organizations may own data that are of limited use unless it is being shared. Therefore, better data, information and knowledge-sharing can add value to both scientific research and practical applications as well as producing positive feedback effects, like guiding science towards new areas of research and using scientific insight to optimize DRR. Data interoperability is a key factor to enable this process. **Data interoperability is the ability of systems and services that create, exchange and consume data to have clear, shared expectations for the contents, context and meaning of that data. With respect to DRR, the lack of data interoperability is no longer an issue of "unexploited potential" but rather a "critical issue".**

In order to achieve data interoperability three key aspects, have to be considered:

Data quality: The degree to which a set of characteristics of data fulfils the selected requirements. Examples of characteristics are: completeness, validity, accuracy, consistency, availability and timeliness.
Data accessibility: The possibility to find, use, and share data.
Data disaggregation: The possibility to break-down data into a more detailed state based on the desired perspective or spatial level.

Data-related challenges in this context refer to any aspect, object or event that may reduce or prevent DRR data interoperability, or any of its three key components (data quality, accessibility, disaggregation). The analysis of the empirical studies highlighted a wide range of data-related issues summarised below in four domains: Technical/Scientific; Social; Economic; and Political/Geographical.

1. The Technical/Scientific Domain

This domain refers to challenges which can be directly originated by (or related to) the operations of data collection, processing and elaboration, and to all the technologies and technical/physical infrastructures involved in those operations. Also, the category includes the problems caused by "time", taking into account that the constant

evolution of data-related technologies and their capacity – in accordance with Moore's Law (Schaller, 1997) – raises the need to integrate new and old paradigms.

Unavailability of disaggregated data at local level is a key barrier to data interoperability. Much DRR-data are very difficult to collect in a disaggregated form required by the Sendai Framework indicators. An example of this can be found in major earthquakes, where data disaggregation of people affected by economic status or disabilities is often missing and cannot be obtained from the local level. Another example concerns disaggregation by individual aspects (age, gender) for buildings owners, whose data are not normally stored/disseminated due to privacy considerations. Also, **the lack of national policies on disaggregated data can be a significant barrier.**

The technical competence needed to collect, store, and refine data are quite often not available at local level. One of the first thing missing is the information about what specific data are needed, for what purposes they can be used and how they can be collected. The smallest municipalities often lack technical capacity and competences, especially when largely staffed by part-time-employees. In some cases, it is not even clear what type of skills and professional backgrounds are needed to fulfil the task. Furthermore, the evolution of software and hardware requires a continuous update of skills which often cannot be afforded by local institutions.

The introduction of new territorial data collection techniques (such as UAV photogrammetry, lidar analysis), as well as of new data treatment software and platforms (and related data-formats), requires a deep scientific background which local data collectors are not able to maintain, nor in some cases even acquire. Data fragmentation is another critical issue, in particular on past disasters data. This issue seems to be due to technical reasons (local municipalities do not have the capacity, tools and infrastructures to collect data with the required level of detail, and some data is not geo-located, including dwellings whose pre-disaster condition cannot often be established), social reasons (seasonal migration makes it difficult to derive data on deaths or injured people), and political reasons (e.g. countries who gained their independence only in recent years lack comprehensive data at the local and national level on disasters and affected people, cultural assets and environment). To avoid the further generation of fragmented data, **there is a major need to increase data availability through open access.**

Another barrier against data interoperability is the persisting heterogeneous nature of different data models, formats, resolutions, software (including GIS platform), user-interfaces, and storing hardware. cloud-computing brings the added challenge of needing constant access to the internet even during emergencies.

Another relevant issue is the lack of infrastructure for DRR data collection and storage in countries. The absence of unified (and disaggregated) databases regarding affected population and in particular on buildings risk parameters (exposure, vulnerabilities), coupled with the lack of data monitoring infrastructures in place, pose a serious threat to performing the disaster impacts assessment required by the Sendai Framework. In some cases, data on evacuated and displaced persons are collected only at local and regional levels but not at the national level. The possibility to include disasters data in Building Information Models was underlined as an interesting option to support the future creation of centralised disaster loss databases. The adoption of non-standard procedures to collect data and existence of non-compatible methodologies is a barrier towards accurate disaster loss assessment. In some cases,

results may be biased by local/individual efforts to exaggerate losses. DRR stakeholders underscored the lack of a unified methodology, and of a unified database to collect data.

Good practice – Montenegro

In 2018, Montenegro started to use UN DesInventar Sendai as its national disaster loss data collection system, integrating all Indicators of targets A to E of the Sendai Framework, also corresponding to Sustainable Development Goals indicators from Goals 1, 11 and 13. In addition to comprehensive disaster accountability, DesInventar Sendai is expected to provide the means for decision-making support for further development of disaster risk reduction policies and plans, preparedness measures, planning and response. A number of initial steps were defined in order to achieve this national level achievement:

1. Thorough analysis and definition of responsibilities among national and local actors.
2. Development of plans of general regulation and update of urban plans in accordance to new Law on Spatial Development and Construction of Structures (2018), including all hazards endangering citizens and environment in Montenegro.
3. Implementation of a National Strategy for DRR (December, 2017).
4. Implementation of the Action Plan for the National DRR Strategy 2018-2023 (March, 2018).

2. The Social Domain

This domain refers to data-related issues which can be linked to people's feelings, perceptions, perspectives and by all related phenomena. The domain also includes all the issues linked to cultural differences, different beliefs, behaviours, languages, practices and expressions considered unique to members of a specific ethnicity or other social group.

Migrations and seasonal migrations impose barriers to properly assess disasters affected population. Data on migrants are often not available, or not up-to-date. Undocumentated migration makes the scenario more challenging, making it impossible to precisely estimate disaster losses in terms of deaths, injured or missing people.

The perception of risk is influenced by many components, among them cultural factors, local traditions and history. The likelihood of disaster occurrence also affects risk perception: for examples, regions that are vulnerable to earthquakes have greater attention towards that specific type disaster, and invest more resources in disaster data collection in that area.

The diversity of collecting entities, institutions and sectors, including healthcare services, IT and telecom operators, insurance companies, practitioners, municipalities, humanitarian associations, and the lack of cross-sectorial communication between those entities pose a relevant barrier against interoperability.

In some cases, a lack of trust in local or national institutions can affect the data collection processes. Aversion towards technological innovation with consequent inadequate training (lack of skills) and incoherent data collection actions (data fragmentation) may also be present. Even if not highlighted as a core issue, language differences still pose a challenge to data interoperability. The presence of incoherent data semantics affects the creation of data models, which can lead to different databases structures. Also, the language itself is a barrier against data accessibility. There is a need to create multilingual sites and increase networking on all levels and scales, in particular between citizens who must be seen as a core resource to improve disasters-related data collection.

Good practice – Slovenia

Since its establishment in 1991 Slovenia has developed a community-based system of prevention which has roots in the Yugoslav tradition and has been constantly upgraded especially after joigning the EU and NATO, and with active involvement in the work of the 3rd United Nations World Conference on Disaster Risk Reduction in 2015. With the latest update on flooding damages, this national damage record system (AJDA [33]) can be used to report to Sendai Framework Monitor. [34]

AJDA is a technical tool to perform damage recording, facilitating data entry at the municipal level, controlling data at the regional and the national level. The system is used to prepare materials for evaluations of damage to crops and property, for the completion of applications by victims to allocate funds, and to address the consequences of disasters. It also enables other government agencies that assess damage to enter estimates. In this way, the procedures for allocating funds to victims have been significantly shortened. The program is intended for disaster relief planning, but can also be used for other analyses.

3. The Economic Domain

This domain refers to data-related issues in liaison with market/business mechanisms, as well as to the lack of financial resources.

The operation of data collection, processing, distribution and update require an appropriate amount of financial resources which seem to be far beyond the currently available resources, in particular at local level. There is a strong need to find new ways to create/collect resources, such as relying on open-data or crowd-sourced data or improving cross-sectorial communication in order to reduce the amount of effort redundancies. Health, insurance, buildings are examples of sectors where data integration would strongly reduce the global amount of financial resource needed.

The constant emergence of new risk assessment paradigms, in particular regarding the logic of multi-risk evaluations and mapping of risks caused by different hazards, requires a continuous training process. This can be economically challenging in particular for local institutions and municipalities. Disaster impact assessments seem to be one of the most affected operations, partly because of the lack of qualified human resources with the sufficient technical capacity to evaluate the impact, and partly because of the lack of financial and logistical resources to carry out the evaluation. Where unified national methodologies are missing, impact estimations can be affected by a strong uncertainty. One such example of uncertainty in assessments is the field of cultural heritage, where the losses estimation is not only difficult to quantify, but also hard to assess by a number of indirect factors (such as tourism, age of buildings) that are very difficult to be precisely estimated.

Private actors such as insurance companies collect and use risk assessment data to plan their business strategies. This can influence the way data is classified and the access to the data might be restricted. Also, insurance claims tend to be formatted in a non-standardized way and not always georeferenced, limiting their usability. Due to this, the problem is not only about accessing valuable data but also about identifying what can be used in meaningful ways for DRR. In some cases, stakeholders highlighted that companies may be pushed to share those data in order to obtain structural help. However in this case, there is a risk that the data is biased, skewed or over-estimated.

The process of aligning existing local databases to new proposed standards pose a further economic barrier. INSPIRE Directive application cases (Migliorini et al., 2015)

[33] *http://ajda.sos112.si/ajda*
[34] *https://sendaimonitor.unisdr.org*

shows that a relevant effort is required from public and private local data owners to align already existing datasets to European data model standards, making funds availability an important driver to enable interoperability.

Good practice – Norway

Addressing the need for high quality data for disaster risk reduction, Norwegian authorities initiated an innovative public private partnership, aiming to develop a knowledge bank relevant for risk assessments and decision-making processes. Structured around a Memorandum of Understanding between national authorities and Finance Norway, the initiative is coordinated by the national platform for DRR, and gathers different sources of data from local level, insurance companies, and disaster risk reduction actors into a national level data-platform. In this integrated approach, the data-platform would receive information about hazards, vulnerabilities, vital functions, societal values, and losses. The platform ensures the interoperability of data, its storage and to systemize the collection process.

4. The Political/Geographical Domain

This domain refers to data-related issues which are related to policy and decision-making process, as well as to the dissemination and adoption of standards and regulations. Data interoperability is affected by the lack of standards alongside the whole chain, including data collection procedures, processing methodologies, data models, data formats, databases and infrastructures. Although international efforts have started to address these challenges more action is required to encourage wider use at national and local level.Local institutions are often not aware of the Sendai Framework which severely hampers the collection of data to derive effective DRR policies and to report progress through Sendai Framework Monitoring process. This implies that international DRR institutions themselves do not have the required feedback to tune global strategies and facilitate their use at national and local level, creating a vicious circle.This issue is especially a challenge in the building sector, with a lack of standardisation for data collection processes, in particular for older buildings. The development of DRR-certification for buildings (similar to energy certification), based on multi-hazard assessment, may be an option to catalyse local investors to improve data collection. Political incentives could also help to speed-up the dissemination of this kind of certification.

Defining competencies of DRR entities and defining responsibilities for implementing DRR data management is challenging. Since this knowledge is missing at the national level, the situation is reflected also at local levels. The unclear attribution of responsibilities for collecting data – including the role of local authorities – contribute to an unstable scenario, made up of scattered data sources and diverse formats.

At the national level, the Sendai Framework is not always perceived a political priority in all European countries. This perception is reflected in the allocation of resources for DRR, several countries do not even have a DRR budget line, resulting in a lack of incentives for prevention and pre-event DRR. Consequently, there is no incentive to create national administrative structures for data collection sharing, and data security.

The knowledge deficit about the Sendai Framework at the local level induces a lack of engagement, perhaps even some resistance. The involvement of more actors in DRR and the implementation of the Sendai Framework, in particular of insurance companies who own themselves a great amount of disaster-related data, seem to be a pathway to mitigate the problem. There is also a need for stronger coordination and governance, focusing on data consolidation and creation of unified data infrastructures.

Good practice – France

Facing challenges in data standardization, national authorities undertook specific efforts for improving identification, collection and use of data for disaster risk reduction. This work resulted in the establishment of a National Observatory[35] coordinated through a public-private partnership between public agencies, Ministry in charge of DRR and the insurance sector. In its current phase, the programme is developing new databases, focusing on exposure and losses from six hazards. One significant value of these systems is its open-access and availability to the general public.

This effort for inclusion and transparency about disaster risk reduction data is also reflected in urban-planning processes, where local authorities systematically call for public consultations and make development and risk maps available to the general public.

Considering the entire cycle of disaster risk management, public and private partners are also working in collaboration to develop a systematic post-event assessment, including different socioeconomic aspects and covering several hazards.

Good practice – The European Union

One European Union directive which could be useful in terms of supporting implementation of the Sendai Framework is the Directive on the re-use of public sector information, also known as the 'PSI Directive' (Directive 2003/98/EC). The Directive is currently being revised, and would be renamed as the Open Data and Public Sector Information Directive and would make public sector and publicly funded data re-usable. The new proposal aims to:

- Reduce market entry barriers, by limiting the exceptions that allow public bodies to charge for the re-use of their data.
- Increase the availability of data by bringing new types of public and publicly funded data into the scope of the Directive (such as data held by public undertakings in the utilities and transport sectors and research data resulting from public funding).
- Minimise the risk of excessive first-mover advantage.
- Increase business opportunities by encouraging the dissemination of dynamic data via application programming interfaces (APIs)

[35] *https://www.oecd.org/governance/toolkit-on-risk-governance/goodpractices/page/francesnationalobservatoryfornaturalhazardsonrn.htm*

To conclude, the issues and barriers related to data are summarized in the following table:

Table 1 Summary of data-related issues by domain.

Domain	Data-related issue
Technical/Scientific	Difficulty to achieve required data disaggregation Data fragmentation Presence of heterogeneous data features and formats Lack of technical skills/competences Lack of data monitoring and storage infrastructures Heterogeneity of data collection methodologies Data updating processes
Social	Migration, displacement, and informal settlements Cultural impact on risks perception and awareness Plurality of data owners Poverty Social resistance Language
Economic	Lack of financial resources for DRR data Lack of financial resources for training Restrictions on DRR data for market purposes Lack of financial resources for standards adoption
Political	Lack of standardisation on all levels Difficulty in identifying competences and responsibilities to support DRR Need for more political support and communication on all levels Need to overcome geographical distribution of disaster related data

5 Conclusions

Important efforts have been made in Europe in the recent decades to increase the structural safety and institutional resilience to natural and other hazards. This has been supported by several UN, EU, and other (inter) national initiatives. All these initiatives benefited from large technological advances (e.g. satellites, real-time data, mobile phones, and unmanned aerial vehicles). **However, Europe lags behind new developments on social capacity building and resilience of population and other social and structural systems (Kuhlicke et al. 2011).**

The gap between scientists, practitioners, policymakers and citizens as well as an imbalanced dominance of emergency management and post-disaster recovery is partly responsible for the challenges identified.

There is still a critical need to increase the DRR-efforts for population groups with either particular individual vulnerability or who are living under structural conditions that makes them particularly vulnerable. For example, the consideration and efforts to be made for addressing resilience of elderly people is central in Europe. Their number and share of the population will considerably increase in the next decades. The ageing population in Europe will considerably lower some social capacities and influence all dimensions of DRR, including the financial.

There is also a need to include new challenges, such as human mobility, considering that migrants may be not aware of the risks when they move to new locations, and the new risks emerging from the large mobilization of people to new areas, including displacement at hazardous events.

The Sendai Framework recognizes the importance of a people-centred preventive approach to DRR that involves all relevant stakeholders in the design and implementation of disaster related policies, plans and standards. Here, the need for the public and private sectors and civil society organizations, as well as academia and scientific and research institutions, to work more closely together and to create opportunities for collaboration, and for businesses to integrate disaster risk into their management practices is critical. Quality-assured, systematically collected and disaggregated data plays an important role for ensuring this interoperability, as well as for measuring progress made and fostering evidence-informed decision and policy making.

Regarding the fundamental question of adaptation to climate change and its potential impacts across European countries, populations and sectors, a number of recommendations can be made. Northern Europe should build resilience for sea-related events, submersive waves, thunderstorms, including strong winds and winter blizzards to increase in frequency and intensity.

Southern countries need to concentrate efforts and build resilience for the fast-growing risk of regional forest fires, droughts and heat waves that can hit large densely populated areas and cause regional economic damage at the scale of the past financial crises.

Mountain regions should support the activities related to mass movements and flash floods. Along with the floods in river basins, these are going to affect the population and infrastructure, especially communications in unprecedented ways.

Specific financial efforts are also needed to support Sendai Framework activities especially at the local level, with initiatives such as the Making Cities Resilient [36] initiative. There is a structural need to empower local authorities to improve capacity building, awareness raising, and increasing resilience. Education will be key at all levels to reach these objectives. Regarding financial resources and investments in DRR, the relations between the national and EU financing

[36] *https://www.unisdr.org/campaign/resilientcities/*

mechanisms are not clear as they overlap at different levels and sectors. High variability was detected between countries. Some countries lack finances and systematic approach, while, however some others consider disaster preparedness and prevention as a continuous goal. Meanwhile, post-disaster, the role of private sector, especially insurance, need strengthening. In some cases, vulnerability and risk analysis are well used to identify sectoral risks such as tourism, but in general there is a lack of good practices, funds and instruments to influence investments.

Regulation of the process of reconstruction or recovery, with careful consideration of the building back better principle, is uncommon, with even specific regulation and plans being developed in the case of major events. Provisions have been made to make exceptional use of state budget and enable shortening of the public procurement procedures to make necessary funds and resources available.

While a majority of European countries show high competence and sustainable leadership in DRR, the topic is not always a high enough political priority to assure implementation and engagement at all levels. This context implies progresses in building knowledge and skills of the political establishment.

In terms of preparedness, most of the instruments are being assigned to national and local administration, often without the necessary legal power. Disaster response has been transferred to local governments, however in most countries they do not have the required expertise, or the necessary financial or human resources to respond accordingly. Most countries have passed regulations to ask local governments to elaborate emergency preparedness plans, however their reactive approach prevents them to successfully address risk reduction and link to other key policies such as land use planning. Plans are mostly focused on evacuation and rescue, but are less advanced with regard to building capacity and enhancing resilience. Multiple and diverse media are being utilized to disseminate information and warn the population about any potential hazard event, and coverage is wide, except for less accessible areas.

There is also a space to replicate good practices of cooperation between civil and military administrations, as well as international cooperation at the European or international levels to share satellite imagery and support preparedness efforts.

A sound understanding of risk does not only mean accounting for the past damage and losses. Natural hazards are outcomes of multiple stochastic processes. On a temporal scale, the probability distributions span over years, decades and centuries. These processes are often not stationary but respond to environmental changes and climate change. The vulnerability and susceptibility to harm are changing as our societies transform in demography, wealth, cohesion and use of technology. In this context, comprehensive and probabilistic risk assessments are needed to complement the recorded disaster losses. Since their inception in late 2000s, the Global Platform for Disaster Risk Reduction[37] and the Global Assessment Report [38] have enhanced in international collaboration at a high policy level across science and policy. Initiated in 2018, the Global Risk Assessment Framework [39] (GRAF) will contribute to better understanding of complex risk and concatenating vulnerabilities, and equip decision makers with tools and scenarios to better understand positive, negative, direct, indirect, intended, unintended as well as short, long term systems impacts and consequences of risks.

[37] *https://www.unisdr.org/we/coordinate/global-platform*
[38] *https://www.preventionweb.net/sendai-framework/gar*
[39] *https://www.preventionweb.net/disaster-risk/graf*

One of the major weaknesses identified is certainly data fragmentation or data unavailability. Across Europe, data types are reported to various degrees, depending on the scale and the type of disaster risk being addressed. This data cannot be validated by cross reference with statistics databases and past events. It is critical to make specific efforts to:

1. Define common terminology and data collection interests
2. Increase resources for research and development of standards and standardized methods and technologies for disaster related data collection
3. Research on use of general public in disaster related data collection
4. Support, promote and dedicate resources for creation of national disaster loss databases compliant with Sendai Framework indicators and terminology, and make full use of data tools being developed to support national actions: DesInventar Sendai, Risk Data Hub, etc.
5. Engage in partnerships with the private sector and other relevant data producers
6. Provide local entities with a clear definition of competences and responsibilities to support quality disaster related data collection
7. Ensure the trustworthiness of disaster related data through data collection standardization
8. Dedicate resources to new and emerging technologies for disaster related data collection

Alongside with standardized methodology and multi-levelled and multi-sectoral structure for data collection, systematic inclusion of the scientific and academic communities in DRR efforts from local to global level must remain a priority. The availability of DRR-data should be also improved through open access The creation of multilingual sites and strengthening of networks at all levels and scales, especially between citizens, should be considered as an essential resource to improve collection of disaster data. Improved data collection and consolidation will allow to better plan prevention, mitigation and preparedness measures to reduce risks and impacts. Fair disaster data will make disaster risks visible and facilitate evidence-based decisions and actions. It is therefore critical to:

1. Promote scientific based decision-making process by national and local authorities
2. Increase resources for research and implementation toward identification of barriers for disaster risk integration in all areas of interest (Technical / Scientific / Economical / Social / Political)
3. Enable geographic distribution of data (and models) to be accessible at all levels.

References

Aysan, Y & Lavell, A (2015). Disaster risk governance during the HFA implementation period. GAR 2015 Background Paper. UNISDR. https://www.preventionweb.net/english/hyogo/gar/2015/en/bgdocs/UNDP,%202014a.pdf

De Groeve, T., Poljansek, K., Ehrlich, D., & Corbane, C. (2014). Current status and best practices for disaster loss data recording in EU member states: a comprehensive overview of current practice in the EU member states. Report by joint research centre of the European Commission, JRC92290. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC92290/lbna26879enn.pdf

Komac, B., Ciglič, R., Erhartič, B., Gašperič, P., Kozina, J., Orožen Adamič, M., Pavšek, M., Pipan, P., Volk, M., & Zorn, M. (2010). Risk Education and Natural Hazards. CapHaz-Net WP6 Report, Anton-Melik Geographical Institute of the Scientific Research Centre of the Slovenian Academy of Sciences and Arts. https://giam.zrc-sazu.si/sites/default/files/caphaz-net_wp6_risk-education2.pdf

Kuhlicke, C., Steinführer, A., Begg, C., Bianchizza, C., Bründl, M., Buchecker, M., De Marchi, B., Di Masso Tarditti, M., Komac, B., Lemkow, L., Luther, J., McCarthy, C., Pellizzoni, ., Renn, O., Scolobig, A., Suprmaniam, M., Tapsell, S., Wachinger, G., Walker, G., whittle, R., Zorn, M., & Faulkner, H. (2011). Perspectives on social capacity building for natural hazards: outlining an emerging field of research and practice in Europe. Environmental Science & Policy, 14(7), 804-814.

Kuipers, S., & Boin, A. (2014). Crisis and Disaster Management in the Netherlands. A Description of Structures and Processes. Crisisplan. https://www.preventionweb.net/publications/view/51636

Migliorini M., Stirano F., Schubert C., Smith R. S., & Smits P., (2015) The use of INSPIRE data models in the realization of a cross-border database. Report by joint research centre of the European Commission, JRC93509. https://joinup.ec.europa.eu/sites/default/files/document/2015-01/ARE-3NA-Reusable_Data_Models_final_report.pdf

Schaller, R. R. (1997). Moore's law: past, present and future. IEEE Spectrum, 34(6), 52–59. https://doi.org/10.1109/6.591665

UNISDR (2017). Disaster-related Data for Sustainable Development. Sendai Framework Data Readiness Review 2017. https://www.unisdr.org/files/53080_entrybgpaperglobalsummaryreportdisa.pdf

Methodology

The experts of the European Science & Technology Advisory Group based their analysis on three sources of information, focusing on overall disaster risk management in Europe, socioeconomic factors, and data management. First, experts used national briefs about DRR context, challenges and opportunities developed by their national counterparts. These briefs particularly underscored existing legislation, governance mechanisms and inclusion of different stakeholders in platforms and decision-making processes.

As a second source of information, a sub group of the E-STAG experts focused on disaster loss data, data collection processes and use of available information. In this regard a specific survey was sent and filled by 65 scientists, data specialists and DRR stakeholders engaged in data production or use. Experts consolidated and analysed data against Sendai Framework set of indicators. Finally, the E-STAG experts developed a 24-questions interview which was conducted with 10 European countries among the 55 covered by the UNDRR Regional Office.

These interviews were administrated by the experts to the National Disaster Risk Reduction Focal Points of the 10 selected Member States. The interview included open and semi open questions, with the aim to precisely understand the challenges, the gaps, but also the good practices experienced by key national stakeholder in implementing the Sendai Framework, and planning the overall DRR agenda.

The information constituted by these three sources, was then analysed by pairs of experts, completed by extensive review of relevant literature and the individual expertise of each E-STAG member. The priorities of the Sendai Framework were used to structure the analysis of all socioeconomic components, when the materials related to data management remained scrutinised through the Sendai Framework set of indicators.
As a result, this report aims to identify national, local and regional elements of context concerning trends, capacities, resources, challenges and gaps to address for improving the interoperability of data in DRR, a better use of available evidence and information for decision-making processes, and a strengthened inclusion of socioeconomic factors.

This report also uses the information collected from Member States for presenting a set of recommendations and a number of good practices that can be adapted and replicated within European countries and abroad.

The elements contained in this report are based (non-exhaustively) on information referring to the following list of Member States: Austria, Belgium, Croatia, France, Germany, Greece, Italy, Israel, Montenegro, The Netherlands, Norway, Russian Federation, Slovenia, Spain, Sweden, and the United Kingdom of Great Britain and Northern Ireland.

Examples of data systems

DesInventar Sendai (www.desinventar.net) - DesInventar Sendai is a new version of the well-tested, widely used software that implements all Indicators and data required for monitoring Targets A to D of the Sendai Framework for Disaster Risk Reduction. DesInventar is mainly implemented at national level for ensuring systematic collection of disaster loss data. The system provides analysis of disaster trends and impacts, and supports implementation of risk assessment and policy-making processes.

Risk Data Hub (https://drmkc.jrc.ec.europa.eu/risk-data-hub) - The main objective of the Risk Data Hub is to improve the access and share EU-wide curated risk data for fostering Disaster Risk Management (DRM). As a knowledge hub, the Risk Data Hub is expected to be the point of reference for curated EU-wide risk data, either through hosting relevant datasets or through linking to national platforms. The Disaster Risk Management Knowledge Centre (DRMKC), which develops the Risk Data Hub, provides also a networked approach to the science-policy interface in disaster risk reduction, across the Commission, EU Member States and other stakeholders within and beyond the EU.

Copernicus (www.copernicus.eu) - Copernicus is the European Union's Earth Observation Programme. It offers information services based on satellite Earth Observation and in situ (non-space) data. Vast amounts of global data from satellites and from ground-based, airborne and seaborne measurement systems are being used to provide information to help service providers, public authorities and other international organisations improve the quality of life for the citizens of Europe. The mapping services provided are partly available in open-access.

The European Forest Fire Information System (EFFIS) (effis.jrc.ec.europa.eu/) - EFFIS is one of the components of the Emergency Management Services (EMS) in the EU Copernicus program. The European Forest Fire Information System (EFFIS) consists of a modular web geographic information system that provides near real-time and historical information on forest fires and forest fires regimes in the European, Middle Eastern and North African regions. Fire monitoring in EFFIS comprises the full fire cycle, providing information on the pre-fire conditions and assessing post-fire damages.

European Flood Awareness System (EFAS) (www.efas.eu) - EFAS is part of the Copernicus EMS. It provides complementary, added-value information (e.g. probabilistic, medium range flood forecasts, flash flood indicators or impact forecasts) to the relevant national and regional authorities. Furthermore, EFAS keeps the Emergency Response Coordination Centre (ERCC) informed about ongoing and possibly upcoming flood events across Europe.

EM-DAT (www.emdat.be/)- EM-DAT provides an objective basis for vulnerability assessment and rational decision-making in disaster situations. It helps to identify disaster types that are most common in a given country and that have had significant historical impacts on human populations. In addition to providing information on the human impact of disasters - such as the number of people killed, injured or affected, EM-DAT provides disaster-related economic damage estimates and disaster-specific international aid contributions.

Danube Reference Data and Services Infrastructure (DRDSI) (drdsi.jrc.ec.europa.eu) – DRDSI facilitates access to comparable and harmonised data sets on various issues related to the Danube Region. This Infrastructure contributes to the holistic scientific approach needed to tackle the interrelated and interdependent challenges which the Danube Region is facing. The goal of the DRDSI is to make data within the Danube Region open and accessible online for all users.

European Facilities for Earthquake Hazard and Risk (EFEHR) (www.efehr.org) - EFEHR is a non-profit network of organisations and community resources aimed at advancing earthquake hazard and risk assessment in the European-Mediterranean area. EFEHR constitutes one of the three service domains in the Thematic Core Service (TCS) Seismology within the European Plate Observatory System (EPOS). The two others are ORFEUS (waveform services) and CSEM-EMSC (seismological products services).

UNDRR

UN Office for Disaster Risk Reduction