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GOOD PRACTICES IN DISASTER PREVENTION

EU funded Programme

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Good practices in disaster prevention

Final Report

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Abbreviation list	
APELL	Awareness and Preparedness for Emergencies at Local Level
AVI DB	Aree Vulnerate Italian database
AZF	AZote Fertilisant, i.e. nitrogen fertiliser (factory)
CC	Climate Change
CCS	Consorcio de Compensacion de Seguros
CEA/DAM/DIF	Tsunami Warning Centre for the Western Mediterranean and North-eastern Atlantic
CFMPs	Catchment Flood Management Plans
CIRCA	Communication & Information Resource Centre Administrator
CNP	National Forecasting Center
CPM	Civil Protection Mechanism
CSR	Corporate Social Responsibility
DEE	Department of Earthquake Engineering
DEMA	Danish Emergency Management Agency
DG ECHO	Directorate-General for the European Community Humanitarian Office
DG ENV	Directorate-General for the Environment
DLRG	German Lifesaving Society
DMPs	Drought Management Plans
DPCM	Directive of the President of the Council of Ministers
DPH	Dominio Público Hidráulico
DR	Drought Risk
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSB	Norwegian Directorate for Civil Protection and Emergency Planning
EDIM	Earthquake Disaster Information System for the Marmara Region
EDO	European Drought Observatory
EDURISK	EDUcational itineraries for RISK reduction
EEA	European Environment Agency
EFAS	European Flood Alert System
EFD	European Flood Directive
EFFIS	European Forest Fire Information System
EFTA	European Free Trade Association
EIA	Environmental Impact Assessment (Directive 2011/92/EU)
EM-DAT	The International Disaster Database
EMSC	European-Mediterranean Seismological Centre
EPA	Environmental Protection Agency (US)
EPBD	European Performance of Buildings Directive
EPPO	Earthquake Planning and Protection Organisation
EQ	EarthQuake
ERDF	European Regional Development Fund
ESF	European Social Fund
EU	European Union
EUSBSR	EU Strategy for the Baltic Sea Region
EWS	Early warning systems
FEMA	Federal Emergency Management Agency (US)

Abbreviation list	
FP	Framework Programme
FRC	Flood Resilient City
FS	Floods and Storms
FSC	Forest Stewardship Council
GDDA	General Directorate of Disaster Affairs
GEM	Global Earthquake Model
GEOSS	Global Earth Observations System of Systems
GIS	Geographic information systems
GIZ/GTZ	German Association for International Cooperation
GMES	Global Monitoring for Environment and Security
GMES GIO	GMES Initial Operations
GNDT	National Group for Protection against Earthquakes
GP	Good Practice
HFA	Hyogo Framework for Action
HHWS	Heat Health Watch System
HM	Horizontal Measure
HWNG	Rhine Floods Emergency Association
ICCO	Industrial Council of Chemical Organisations
ICPDR	International Commission for the Protection of the Danube River
ICPR	International Commission for the Protection of the Rhine
ICSU	International Council for Science's
ICTs	Information and communications technologies
IERREWS	Istanbul Earthquake Rapid Response and Early Warning System
IFRC	International Federation of Red Cross and Red Crescent Societies
IMPEL	Network for the Implementation and Enforcement of Environmental Law
INTERREG IVC programme	INTERREG IVC provides funding for interregional cooperation across Europe
IPCC	Intergovernmental Panel on Climate Change
IRDR	Disaster Loss Data Working Group of the Integrated Research on Disaster Risk
ISO	International Standards Organisation
ISSC	International Social Science Council
JRC	Joint Research Centre of the European Commission
KAS	Kommission für Anlagensicherheit
KNMI	Royal Netherlands Meteorological Institute
KOERI	Kandilli Observatory and Earthquake Research Institute
LDG	Laboratoire de Détection et de Géophysique
MAHB	Major Accident Hazards Bureau
MARS	Major Accident Reporting System
MATRIX	New Multi-Hazard and Multi-Risk Assessment Methods for Europe
MHIDAS	UK Major Hazard Incident Data Service
MICORE	Morphological Impacts and COastal Risks induced by Extreme storm events
MS	Member State
MSB	Swedish Civil Contingencies Agency
NATECH	Natural-hazard triggered technological accidents
NDGDM	Hungarian Platform for Disaster Reduction
NEAREST	NEAR shore sourcES of Tsunamis
NGO	non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
ORFEUS	Observatories and Research Facilities for EUropean Seismology

Abbreviation list	
PDSI	Palmer Drought Severity Index
PEFC	Programme for the Endorsement of Forest Certification
PERILS	Pan-European Risk Insurance Linked Services
PFRA	Preliminary Flood Risk Assessment
PGRI	French management plans for flood risk
PPR	Plan de Prévention des Risques
PPRD	Prevention Preparedness and Response to Natural and Man-Made Disasters
PPRT	Plan de prévention des risques technologiques
PSHA	Probabilistic Seismic Hazard Analysis
RCC SEE	Regional Cooperation Council of South-Eastern Europe
SCHAPI	Service Central d'Hydrométéorologie et d'Appui à la Prévision des Inondations
SEA	Strategic Environmental Assessment (Directive 2001/42/EC)
SEEC CRIF	South East and Caucasus Catastrophe Risk Insurance Facility
SEVESO Directive	A directive that aims at the prevention of major-accident hazards involving dangerous substances, after the Seveso disaster
SFRAs	Strategic Flood Risk Assessments
SIPE	National Emergency Planning System (SIPE
SME	Small and medium enterprise
SNCZI	Sistema Nacional de Cartografía de Zonas Inundables
SNIRH	Sistema Nacional de Informação de Recursos Hídricos
SPC	Flood forecasting services
STC	UNISDR Scientific and Technical Committee
SWOT	Strengths, Weaknesses, Opportunities, Threats
UCL	University College London
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNISDR	United Nation Office for Disaster Risk Reduction
WFD	Water Framework Directive (2000/60/EC)
WWF	World Wildlife Fund

Executive Summary

Natural and manmade disasters continue to have devastating effects on communities throughout Europe and beyond. Disasters often cross national borders, which emphasises the need for international co-operation and exchange of resources, experiences and knowledge. Europe has been spared from extreme events such as Hurricane Katrina, which took somewhere around 1 800 lives and destroyed property worth billions of Euros. Nevertheless, floods in the United Kingdom, heat waves in Southern Europe and numerous industrial disasters remind us that Europe is not spared from hazards. Moreover, climate change is expected to put additional pressure on our natural system and lead to more frequent and more intense natural disasters. The increased human and economic costs from disasters call for improvements in disaster risk management (DRM) in Europe.

To tackle larger and more frequent disasters requires improvements in DRM. While all parts of the disaster management cycle (prevention, preparedness, response, recovery, mitigation) are important, it is increasingly understood that prevention is a cost-effective and legitimate way to avoid large scale damage[1]. The European Union (EU) has set out to create an improved, more streamlined, European approach to DRM that pools our resources and intensifies international collaboration, to reduce the vulnerability of people and communities and increase the resilience against disasters.

The current European policy framework on DRM is a patchwork of strategies, disaster specific policies and sectoral initiatives. To harmonise the framework, the European Parliament, the Council and the EU MS have – in accordance with the 2008 Communication from the Commission on Reinforcing the Union's Disaster Response Capacity[2] – called for an integrated approach to cope with disasters in Europe. In November 2009, the Council agreed upon Conclusions for a Community Framework on Disaster Prevention within the EU, setting an EU prevention policy framework that aims to increase the resilience to disasters and foster a culture of prevention and risk management across the EU. While the Community Framework focuses on Europe, it would also help to implement the Hyogo Framework for Action (HFA) 2005 -2015.

The conclusions specifically refer to the importance of MS sharing knowledge on good practices (GPs) for the prevention of disasters. Furthermore, the Council conclusions call upon the Commission, together with MS, to develop guidelines on minimum standards for hazard-specific disaster prevention, in particular for those risks shared by MS or regions within them.

The good practices programme

To establish GP guidelines that build upon existing knowledge, the Commission has launched a disaster prevention GP programme entitled “Strengthening the EU disaster management capacity – Good Practices on Disaster Prevention”. The programme aims to collect information from all MS across natural and manmade disasters regarding measures taken to prevent disasters and reduce vulnerability. With the understanding that prevention programmes for different disaster risks can benefit from a more integral approach, the Commission has particularly focused on identifying horizontal measures (HM) in MS.

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1 World Bank, 2010. Natural hazards, unnatural disasters: the economics of effective prevention. The World Bank and The United Nations.

2 EC, 2008. Communication from the Commission to the European Parliament and the Council on reinforcing the Union's disaster response capacity. COM/2008/0130 final.

The programme is expected to lead to the adoption of EU guidelines on minimum standards for disaster prevention. The minimum standards would be non-binding and focus mainly on HM and potentially on a few sectoral initiatives. They should reflect those ongoing initiatives in MS that have been considered useful to upscale to a European level. In this sense the minimum standards are developed with a fact-based approach, building on examples of GPs in disaster prevention. To this end, the Commission ordered a report with three goals: (1) to compile an inventory of GPs in DRM across five themes – floods and storms, droughts and fires, earthquakes and tsunamis, industrial hazards and horizontal issues – from all over Europe as well as a few non-European countries; (2) to analyse the GPs in order to find general trends in how and why GPs occur; and (3) to propose a number of draft guidelines for minimum standards on disaster prevention. The following report is the end-result of this exercise.

Approach

The study team quickly realised that the term "inventory", which connotes an exhaustive list of all GPs in Europe across all themes, became an overwhelming task. The end result is a non-exhaustive list of over 400 practices in Europe on DRM, ranging from legislation to public-private partnerships. The process of compiling the practices included contacting all countries in the Civil Protection Mechanism (CPM), carrying out interviews with over 20 experts and distributing surveys. The list of practices has been amended throughout the project and the robustness of the sample was verified in five workshops held in Brussels in April and May 2012. The study team acknowledges however, that there may be practices missing but is confident that the list has provided a sound basis for further analysis.

In the second step, the lists of practices were subjected to scrutiny by the experts in the team, as well as external experts, EU MS representatives, and the Commission's working groups on specific hazard themes, via the workshops held in Brussels. In close co-operation with the Commission, the study team evaluated the practices and chose a smaller selection of GPs from the initial inventory; since not all GPs could be analysed in detail, the study team focused on picking out a few that were deemed most relevant for featuring as illustrative examples for the guidelines on minimum standards for DRM.

Finally, based on the GPs collected in combination with peer-reviewed literature and reports from international organisations such as the United Nation Office for Disaster Risk Reduction (UNISDR), the study team distilled guidelines for minimum standards on DRM.

Towards guidelines on minimum standards for disaster risk management

The guidelines on minimum standards for DRM have been divided into five sections: (1) Governance, (2) Planning, (3) Information and Capacity Building, (4) Disaster Loss Data, and (5) Putting Research into Practice.

Governance – ensure an integrated governance approach to disaster prevention

Governance defines the basic framework for DRM. Good governance requires authorities, industry and civil society to work across administrative and geographical borders to foster a culture of disaster prevention. On a regional and local level, the principles for setting up an effective institutional arrangement are equally important as those on a national level. The organising principle of subsidiarity may be useful where the issues are dealt with at the lowest level of authority possible and capable of effective implementation. Integrated multi-level governance needs to be promoted, ensuring adequate financial and human resources, as well as clarifying the division of tasks and responsibilities at appropriate levels. This includes:

- At the national level, develop a horizontal mechanism to co-ordinate disaster prevention across a range of agencies and stakeholders, such as a platform for disaster risk reduction (DRR), that

may include sectoral agencies that do not have primary responsibility for prevention, such as those responsible for housing, infrastructure, utilities, health care, economic and land use planning, etc., as well as those primarily engaged in emergency response and recovery:
  - Distribute responsibilities and tasks to the most appropriate levels (which are often local);
  - Allocate appropriate human and financial resources for authorities to carry out DRM tasks, as well as involve other sectors of society through innovative partnerships such as public private partnerships with voluntary organisations, research academia and businesses.
- At the regional and local levels, develop a horizontal mechanism to co-ordinate disaster prevention across a range of stakeholders from government, business and civil society, to foster a culture of disaster prevention at a sub-national level by collaboration and inclusiveness:
  - Ensure good lines of communication across vertical and horizontal scales;
  - Support community based approaches to strengthen the resilience of the population and communities at a local level.
- Governance for risk prevention of specific disaster types, such as industrial risks and floods, acknowledges that hazards are not prevented in isolation and adopts a multi-hazard and cross-sectoral perspective in addition to the single risk/sector approach.

A comprehensive legislative and institutional arrangement on a national, regional and local level is only a first step in the direction of effective DRM. Rules need to be coherent with existing legislation, monitoring mechanisms should be in place, enforcement should be possible and feed-back must be provided to adapt the system to external changes. Further, innovative approaches to improve implementation and adaptive governance, such as peer-reviews used by the Network for the Implementation and Enforcement of Environmental Law (IMPEL), should be promoted.

Disasters and risks do not respect national borders. Floods, forest fires and drought, for example, regularly occur in border areas between MS and require authorities to co-operate in order to optimise disaster prevention. Cross-border co-operation should therefore be considered when making national policies, legislation, plans and actions to address risks that cross national borders:
- Promote new cross-border co-operation mechanisms and projects for risk prevention in regions that share common disaster risks and support and enhance existing ones;
- Implement and develop existing international, EU and bilateral legislation and plans/strategies with relevance to disaster risk prevention.

Disaster prevention is both affected by and in turn affects, a number of policy fields. Thus, it is important to mainstream DRM across EU sectoral and hazard-specific legislation. Moreover, harmonisation of standards and language on DRM is important:
- Policies and legislation at EU, national and local levels should integrate DRM across sectoral and hazard-specific legislation and promote harmonisation and standardisation in appropriate fields, to enable knowledge sharing and comparison between MS;
- Mainstream DRM into sectoral legislation and planning such as construction, spatial planning and water, as well as into sustainable development policies such as environmental policies, social policies, health etc.

Authorities dealing with DRM should also ensure that actions are adapted to more extreme climatic scenarios by mainstreaming climate adaptation into policy making at all levels. It means that climate adaptation and DRR strategies and policies are aligned and developed in close co-operation, which is commonly not the case. The following actions are proposed:
- Mainstream climate change into spatial planning by carrying out risk assessments and regulations for the new development of buildings;
- Develop mechanisms to ensure integration between strategies and policies in DRR and climate change adaptation, at all scales;

- Recognise that response to climate change must be flexible and dynamic over time.

Planning

Planning can be defined as the process undertaken by authorities and other stakeholders to identify, understand, assess, and plan for addressing disaster risks via holistic decisions on policy options. Effectively, sound planning for DRM starts with carrying out a multi-hazard risk assessment with appropriate methods and technologies. Based on the results of the risk assessment, risk management plans are set up and results are factored into other decision-making for planning processes, such as short term and long term development policies (land use planning, citing of critical infrastructure, etc.), recovery measures, capability and response planning, etc. This does not necessarily mean that one multi-hazard national risk assessment is sufficient. Rather, risks need to be analysed at all levels of government, from a single and/or multi-hazard perspective (depending on circumstances) and should be streamlined across sectors. To successfully integrate multi-hazard risk assessment into planning for DRM at the local, regional and national levels, the following guidelines are proposed:

- Promote the use of risk assessments for planning purposes at all levels of government;
- Stimulate business continuity planning for making the private sector more resilient;
- Strengthen methodologies for multi-hazard and single hazard risk assessment. A common approach and the linking of various existing sector and/or hazard-specific risk assessment methodologies are desirable;
- Develop general guidance documents on how to carry out and use risk assessment, based on EU Guidelines and existing sectoral and hazard-specific risk assessment methodologies, to steer regional and local approaches and harmonise planning for DRM;
- Ensure clear mechanisms are in place to link multi-hazard risk assessment with decision-making for DRM planning;
- Foster a culture of risk assessment wherein regular updates are carried out to account for potential changes in risk factors;
- Urge the development and implementation of risk management plans for prevention;
- Encourage multi-sectoral plans that address multiple hazards and are developed and implemented with active participation from a wide range of public and private stakeholders.

In addition, the use of appropriate specific sectoral and single-hazard assessment methods and technologies should be encouraged, to aid in the risk assessment and planning procedures and refine their accuracy. These include, for example, hazard and/or sector-specific micro-zoning, hazard mapping, risk modelling, construction codes and early warning. Evidence from GPs allows for the proposal of the following guidelines for action:

- Encourage regular updating of existing or the development of new building design codes and standards at the national or local levels, as appropriate, as a key tool for directing structural planning for greater resilience;
- Reinforce capacities at relevant levels of government (national, regional, and local) to implement, monitor and enforce specific DRM planning mechanisms, such as zoning of critical infrastructure or building design codes;
- Foster a common approach to the international standardisation of micro-zoning techniques, including parameters, methodologies and technologies, and encourage their application on a large scale basis;
- Develop Probabilistic Seismic Hazard Assessment (PSHA) and mapping, to be the reference methodology for seismic zonation and seismic action levels of the National Annexes of Eurocode 8;
- Promote the use of risk modelling as a powerful analysis tool for tailor-made, needs-based risk analysis for guiding policy decisions;

- Address implementation deficit of Eurocode 8, possibly via the introduction of inspections and monitoring throughout the construction process;
- Promote research efforts and further harmonisation of EWS in their role as a planning tool for prevention;
- Assure continuous improvement and functioning of databases and the sharing of access to data and information that EWS depend on between all relevant levels of government within one country, cross-border and internationally;
- Ensure that EWS are sufficiently location-specific so as to be sensitive to cater to the population they intend to warn, i.e. understandable communication taking into account culture, livelihood characteristics, vulnerable groups, gender, etc.

Another important aspect of planning is to consider how to ensure that new investments are disaster prevention proof. GPs in Europe show a clear potential for the EU to play a role in steering its investments towards mainstreaming disaster prevention considerations for new infrastructure and/or development projects. Such 'prevention-proofing' of investments can be ensured via relevant criteria for design, approval and implementation of new programmes, projects or funding streams:

- Guide EU, national and private investments to account for disaster risk by applying disaster prevention considerations via relevant criteria for design, approval and implementation of new programmes, projects and funding streams;
- Encourage MS to make use of available funds from the EU Cohesion policy as well as other available EU funding programmes;
- Offer EU assistance on how MS could build prevention-proofing measures into their own funding programmes;
- Link prevention proofing and climate proofing efforts whenever possible.

Similarly, the integration of DRM into post-recovery actions should be fostered. In the rehabilitation and recovery phase of the disaster management cycle, it is important to address underlying vulnerabilities that had previously prevented safe construction and therefore limited durability and sustainability of infrastructure:

- Link national and EU financial assistance granted in the recovery phase directly to an obligation to introduce "build back better" approaches such as improved infrastructure that will be more resistant to future events, or the relocation of infrastructure to safer areas.

Well-structured and balanced financing mechanisms for DRM create trust, certainty and continuity of the planning process, and particularly its implementation. Even though MS throughout Europe are exposed to different types of disaster risks and existing risk insurance systems are highly diverse, risk insurance can benefit from following some common principles, including:

- Raise awareness regarding the important links between risk management planning and financing issues;
- Encourage public-private partnerships for risk transfer to support planning backed up by a solid risk insurance system;
- Use incentives such as insurance risk premiums to foster disaster prevention measures;
- Foster 'responsibility sharing' for prevention between stakeholders as a principle of sustainable and affordable insurance;
- Prioritise risk insurance systems covering multiple-hazards to a single-hazard based system as it provides greater trust in the system among society and can spread costs across more actors;
- Promote risk insurance standardisation products and processes based on common principles across Europe, including the harmonisation of post-disaster assistance policies, as well as education and public information campaigns, while at the same time allowing sufficient flexibility for Member States to pursue tailor-made risk insurance solutions;
- Encourage pay-out independent of official disaster declaration;

- Foster continuous creativity and diversity in finding the best possible way forward for financing disaster prevention.

Information, awareness raising and capacity building

Risk communication aims to influence the thinking and behaviour related to risk. It is intricately linked to capacity building on an individual, community and organisational level. On an individual level it can be used to generate knowledge on how to interpret and act on risk information. On a community level it can be used to create ownership within communities of communicating risks and enabling co-operation among individuals, groups and organisations. Moreover, a precondition for authorities and communities to manage and prevent risk is access to accurate and timely information. Given the often-decentralised organisation of DRM, local authorities and risk managers in particular need the know-how and technical knowledge for how to translate often-complex data into appropriate measures. Consequently, risk communication and capacity building are two sides of the same coin, both reinforcing each other in making DRM more effective. To this end, an integrated approach to awareness raising, education, and capacity building for authorities and communities should be promoted, including:

- Campaigners and authorities responsible for information dissemination should ensure that integrated information and awareness raising campaigns are designed to meet the needs of different groups in society, including vulnerable groups, by identifying the needs and information channels most effective for spreading information on DRM;
- Identify and target the most vulnerable groups in society and capacitate them to understand what measures can be taken to prevent disasters;
- Integrate DRM into school curricula by providing material for teachers to deliver and communicate to school children and adolescents in the most appropriate way;
- Develop, update and maintain an online portal or webpage for information on all types of disaster risks and how to prevent them;
- Support innovative and unconventional approaches to information dissemination and awareness raising.

Further, participatory approaches in communicating risk have become increasingly recognised as a necessary component in good DRM. To foster these approaches, proposed actions include:

- Ensure that communities participate in planning, implementation, monitoring and capacity building;
- Implement feedback mechanisms in training and capacity building, to ensure improvements in materials and content for future participants;
- Promote the adoption and implementation of legal instruments that ensure citizens' participation (or representation) in DRM and access to information on potential risks to their community;
- Support participation by volunteerism.

Authorities in charge of DRM have an obligation to prevent disaster risks. Often based in agencies on the national, regional and local levels, the staff in these authorities must have adequate knowledge on how to draw up and implement strategies for DRM. Capacity-building should include:

- Capacitate media and journalists to disseminate appropriate information on DRM by providing trainings and materials on how to interpret, report on, and spread information on disasters;
- Capacity-building and high-level advice to professionals should emphasise the need to move toward prevention.

Disaster loss data

A first step in DRM is the assessment and characterisation of key risk factors. To understand and manage risks appropriately requires observing and recording hazards and studying exposure and vulnerability. Therefore, disaster loss databases with validated data and inventories represent an

essential basis upon which to build and implement efficient and effective DRM policies and programmes. In order to ensure that disaster loss databases reach their intended goals, it is essential that the database is embedded in an enabling environment that makes the system work. GPs have shown that such an environment, though partly location specific, exhibits various key features. This entails the following guidelines for action:

- Ensure clear ownership structures of the database and firm integration as a central tool for DRM;
- Identify and commit counterpart agencies as well as human and financial resources at all levels of government;
- Offer continuous training and technical advice for all staff involved at government levels, as well as implementing partners;
- Promote the importance of disaster loss databases by explaining the use and benefits of such databases for DRM planning and policy development, planning and programming;
- Encourage regular reviews and updates of the database with clear links to “lessons learned” programmes set up following disaster events.

The review of GPs has shown that an improvement in disaster loss information on the international and national levels is not sufficient. In particular, for translating the information into action for DRM, context-specific variables need to be added on a more local scale. This requires good co-operation of all actors involved across hazards, sectors, agencies and levels of government. Multi-hazard, multi-scale (context-specific) disaster loss databases for informing DRM processes in Europe need to be developed. This includes the following guidelines for action:

- Ensure the inclusion of context-specific variables and resolutions for informing DRM at the local level;
- Encourage a multi-hazard character for the disaster loss database;
- Cover large, medium and small scale disaster events;
- Ensure the ability to scale down loss information to the sub-national and local levels for informing the DRM process;
- Comprise adjustability across spatial resolution (regional, national, local) in order to cater to specific audiences and their context-specific needs for risk information;
- Generate locally customised user manuals and trainings to accompany the implementation of the disaster loss database.

More attention is also required in order to identify what type of information and content is really essential for these disaster loss databases, to be able to adequately inform the various stages of DRM. This involves the development of common terminologies, input variables and methodologies for data collection, validation and analysis. Such definition of standards aids inter-operability and comparability of data. Proposed guidelines for action include:

- Establish universally shared basic operational definitions of key terms by adopting and cross-referencing the existing UNISDR and International Standards Organisation (ISO) risk terminology and urge further harmonisation of key terminology particularly relevant for disaster loss databases, namely: definition of a ‘disaster’/‘catastrophe’; definition of a ‘loss’; differentiation between ‘insured loss’ and ‘uninsured loss’; ‘direct’ versus ‘indirect’ losses; ‘economic’ versus ‘social’ versus ‘environmental’ losses; ‘total loss’ (loss-only versus loss/gain calculations); definition of fatalities (what is a ‘dead’ versus a ‘missing’ person versus an ‘injured’ person, and what is ‘total affected’ people);
- Follow the minimum quality criteria for databases in Europe proposed at the European expert meeting under the European Environment Agency (EEA) umbrella;
- Develop a list of key basic indicators/input variables to be taken into consideration when elaborating disaster loss databases;
- Encourage common prerequisites for methodologies for data collection, validation and analysis;

- Support the development of national multi-hazard disaster loss databases along the lines of the DesInventar Methodology.

Information and communications technology (ICT) systems are major tools in facilitating the necessary international exchange and dissemination of the disaster loss data and information. To this end they need to be user-friendly and globally accessible online, for data sharing and retrieval.

Putting research into practice

Science, knowledge and research play an essential role in securing effective DRM. To ensure that science and research reaches "beyond the ivory tower" however, there needs to be an active and sustained collaboration and dialogue within the scientific community across disciplines as well as between scientists and policy makers, planners, and other relevant stakeholders.

Related to the use of science in planning is the often missing link between natural and social sciences. To fully integrate hazard exposure and social vulnerability in comprehensive vulnerability assessments, for example, one needs to engage natural scientists in providing data, models and methods for exposure assessments and the social scientists to identify vulnerable groups and the population at risk.

To secure greater uptake of science in policy-making, planning and the implementation of DRM, the following guidelines for action are proposed:

- Encourage technical and social scientific research on natural hazards and their predictability, as well as on possible ways by which to mitigate the impact of both natural and industrial disasters on the population;
- Determine how scientific results may be provided to decision-makers in a useful way;
- Encourage work across disciplines both within and between the social and natural sciences;
- Support bottom-up use of scientific information.

1 Why a study on good practices for disaster prevention

Natural and manmade disasters such as floods, storms, forest and grass fires, industrial accidents, tsunamis and earthquakes impact the lives of millions of people. Besides the toll on human life and livelihoods, the economic cost has increased significantly and in 2011 a new historical record in global costs for natural disasters was reached.

Europe has been spared from record-breaking disasters such as Hurricane Katrina that hit the south coast of the United States in 2005 or the 2011 earthquake and tsunami in Japan. Nevertheless, floods, droughts, and industrial hazards are not uncommon in Member States (MS) of the European Union (EU) and climate change is likely to augment the threat caused by disasters. As recently as the last few years the UK and Ireland have been plagued by floods, droughts hit Spain, France, Portugal and Greece, and earthquakes in Northern Italy killed more than 25 people.

Over the past decade, EU co-operation in disaster management and humanitarian aid has evolved significantly shifting from response towards a more balanced and advanced system covering also preparedness and prevention actions. To reduce the vulnerability of people and communities and increase the resilience against disasters, the European Parliament, the Council and the EU MS have – in accordance with the 2008 Communication from the Commission on Reinforcing the Union's Disaster Response Capacity[3] – called for an integrated approach to cope with disasters in Europe. In an integrated approach, the entire disaster management cycle, from prevention to recovery, is taken into account when designing policy responses.

Disaster prevention and risk management in particular are increasingly being recognised as a legitimate and cost-effective way to reduce the human and economic costs of disasters[4]. In November 2009, the Council agreed upon Conclusions for a Community Framework on disaster prevention within the EU, setting an EU prevention policy framework that aims to increase the resilience to disasters and foster a culture of prevention and risk management across the EU. While the Community Framework focuses on Europe, it would also help to implement the Hyogo Framework for Action (HFA) 2005 -2015.

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3 EC, 2008. Communication from the Commission to the European Parliament and the Council on reinforcing the Union's disaster response capacity. COM/2008/0130 final.

4 World Bank, 2010. Natural hazards, unnatural disasters: the economics of effective prevention. The World Bank and The United Nations.

benefit from a more integral approach, the Commission has particularly focused on identifying horizontal measures (HM) in MS.

The programme is expected to lead to the adoption of EU guidelines on minimum standards for disaster prevention in 2013. The minimum standards would be non-binding and focus mainly on HM and potentially on a few sectoral initiatives. They should reflect those ongoing initiatives in MS that have been considered useful to upscale to a European level. In this sense the minimum standards are developed with a fact-based approach, building on examples of GPs in disaster prevention at European, national and local levels.

1.1 Purpose and structure of the study

The main purpose of the study is to support the Commission in implementing the GP programme and to develop guidelines for minimum standards or principles of GP in disaster prevention in Europe.

To reach the objective, the study team divided the study into three tasks: (1) collect a non-exhaustive list of practices in disaster prevention, in all MS participating in the Civil Protection Mechanism (CPM); (2) establish what constitutes a GP in disaster prevention and select an illustrative list of GPs across a range of activities based on a set of selection criteria, and (3) translate these GPs into guidelines for minimum standards for disaster prevention.

To create an inventory and assessment of GPs in different areas prior to drafting guidelines for minimum standards on a more horizontal level, five themes have been identified: (1) horizontal measures (multi-sectoral and/or multi-hazard measures and practices); (2) earthquakes and tsunamis; (3) floods and storms; (4) heat waves, droughts and forest fires; and (5) other measures, especially transportation of dangerous goods and industrial hazards.

The study is structured as follows:

- In **chapter 2**, the methodological considerations and tools are explained. It is an important part given that there is much ambiguity on what constitutes a GP and how one translates them into guidelines for minimum standards;
- In **chapter 3**, the results of the collection of practices and selection of GPs are presented. It is divided according to hazard themes and includes a short introduction to the peculiarities of each hazard;
- In **chapter 4**, the analysis of the compilation of GPs is made. It introduces a more horizontal approach and attempts to find general trends in GPs. It is therefore divided into topics, namely: governance, planning, disaster loss data, information and capacity building, and putting research into practice;
- In **chapter 5**, we attempt to start the translation of the GPs into guidelines for minimum standards for disaster risk management (DRM). It relies heavily on chapter 4 and aims to be readable independently of the other chapters in the report, which means some overlap with chapters 3 and 4;
- Finally, in the Annexes we present the immense data collection effort made for the study including the inventory with over 420 practices, the workshop reports, interviews, and survey.

2 Approach

There are a great number of good practices (GPs) in disaster prevention to be found in Europe and beyond. The challenge for the study team was to collect a representative sample of practices, to judge whether a practice can be considered "good" and finally to translate the GPs into draft guidelines for minimum standards. Consequently, the research process was divided into three main parts (1) collection of an inventory of GPs in disaster risk prevention; (2) assess what constitutes a GP, and (3) begin the translation of GPs into minimum standards for disaster risk prevention.

For practical reasons the study team has mainly used qualitative research approaches such as literature reviews, expert judgement, interviews, and stakeholder workshops to collect and verify data, methods and outcomes. Comprehensive, comparable and robust data on disaster prevention that would enable more quantitative approaches is nearly non-existent in Europe. It is something that is addressed in the conclusions of the study and involves, for example, data on disaster loss, costs for prevention measures, and quantifiable benefits from prevention activities.

The scope of the study has been the 27 Member States (MS) of the European Union (EU) and the other countries participating in the EU Civil Protection Mechanism (CPM), since the study is intended to prepare for (non-binding) EU guidelines. We would like to emphasise that practices from outside Europe have been included in the inventory on an ad-hoc basis to illustrate certain aspects of disaster risk prevention, however they have not been systematically collected.

The following sections are divided into four parts: first, the definitions of key concepts are explained; second, the data collection methods are outlined; third, each task is explained in detail; and finally, a commentary on the methodological shortcomings is provided.

2.1 Working definitions of key terms

To better understand what the core concepts of the study are, the study team has developed, in close consultation with the Commission, working definitions of GPs and minimum standards.

Our 'working definition' of **disaster prevention** is: *Measures taken to avoid or minimise the adverse impacts of hazards and related disasters*. The study team has approached disaster prevention quite broadly, taking into consideration preventive "build back better" measures implemented during the recovery phase. This includes the prevention and mitigation of the risk transfers, improved preparedness and early warning systems (EWS)[5]. Therefore, certain recovery and preparedness measures that inform disaster prevention have been included in the scope of this study.

Our 'working definition' of a **good practice** is: *A measure for which there is demonstrable evidence of effectiveness in increasing prevention, and for which there is demonstrable evidence that it is appropriate and feasible to apply*. Note that demonstrable evidence refers to project data clearly showing effectiveness, feasibility, etc. or other information sources such as an audit or expert review of the measure.

[5] It became clear that lines between disaster risk prevention and preparedness are sometimes blurred. For example, in the theme on seismic hazards and tsunamis it becomes irrelevant to talk about prevention of the hazard.

The purpose of the project is to derive guidelines for 'minimum standards' on disaster prevention in Europe that builds upon existing sectoral legislation and initiatives, such as the Floods Directive or the SEVESO Directive. The minimum standards are meant to be non-binding and aim to fill gaps and reinforce the implementation of existing EU legislation, primarily on a horizontal and multi-hazard level. Minimum standards should provide effective methodologies for trans-disciplinary (multi-hazard) and multi-sectoral co-operation: they should serve as models for generating policies and initiatives across MS for the effective implementation of preventive measures by the competent national authorities. They should be feasible and applicable as demonstrated by existing GPs.

2.2 Information collection & expert input

A large amount of data has been collected during the course of the project via desk research, telephone interviews, workshops and a survey. A major and time-consuming task was the compilation of practices.

2.2.1 Desk research

The initial compilation of the inventory was done through Internet based searches for examples of GPs. Websites of competent authorities, initiatives, international organisations and databases have been in focus.

The study team also contacted key stakeholders, mainly staff in civil protection agencies in 30 countries including all 27 EU MS and the other CPM countries (Iceland, Liechtenstein, Norway, Former Yugoslav Republic of Macedonia) plus Turkey, Australia, New Zealand, USA and Switzerland via email and telephone to provide input from their respective countries to the inventory. The input from MS was highly varied, where some countries actively and enthusiastically provided input for the inventory, while others proved more difficult. It may explain some of the variation in frequency of how the countries are represented in the dataset. Through-out the project, MS were given the possibility to amend or subtract practices from the inventory. It is also important to note that the inventory is by no means intended to be exhaustive. It merely provides a representative sample of practices from all EU MS. The result of the desk research was a long-list of over 600 practices for each theme.

In the assessment of what constitutes a good practice and in the creation of guidelines for minimum standards, literature from both European and non-European countries has been used. In particular, work from international organisations such as the United Nations Environment Programme (UNEP), the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the Intergovernmental Panel on Climate Change (IPCC) and the Organisation for Economic Co-operation and Development (OECD) have been useful in this regard. Sources are quoted in footnote format throughout the report and Annex E includes a final overview of all literature used.

2.2.2 Telephone interviews

Once the initial inventory of good practices had been collected, the study team set up interviews with 24 experts across the themes. The respondents were selected in close co-operation with the Commission and other thematic experts relevant to each study theme. The semi-structured telephone interviews were conducted with the relevant thematic experts from the team. The interviewees were sent the draft overview of practices and a preparatory text in due time before the interview was held. Each interview lasted 30 – 90 minutes depending on the person being

interviewed. Nearly all respondents were happy to be mentioned in the report, however, it was generally agreed that specific comments and viewpoints would not be attributed to individuals.

The interviewees were asked to focus on three key questions:

1. *Which practices can be considered good and if so, why?*
2. *Which practices, if any, would you delete from the list as they do not represent good practice?*
3. *Based on the list of good practices, what minimum standards for disaster prevention should be considered?*

Minutes were taken for each interview, which were sent to the respondent for validation including additional comments and/or correction. In total, 24 expert interviews across the five themes have been carried out. The table below shows all the experts interviewed and their affiliations.

Table 1: Overview of experts interviewed for good practice collection

Theme	Name	Affiliation
Horizontal measures	Paola Albrito	UNISDR
	Eugene Gurenko	World Bank
	Asim Rehman	UNICEF
	Sophie Rocks	Cranfield University
	Martin Studdert	Formerly of Emergency Management Australia
	Stephen Barnes	UK HFA Focal Point
Earthquakes and tsunamis	Gerassimos Papadopoulos	National Observatory of Athens
	Eleftheria Papadimitriou	Aristotle University of Thessaloniki
	Margarita Matova	Geological Institute Laboratory of Seismotectonics
Floods and storms	Wouter van Neuville	EEA
	Gabor Balint	The Hungarian National Hydrological Forecasting Service
	Tomasz Walczykiewicz	Institute of Meteorology and Water Management
	Siegfried Demuth	UNESCO
Heatwaves, Droughts and Forest Fires	Luis Garrotte	Technical University of Madrid
	Antonio Biscione	Autorita' Di Bacino della Basilicata
	Gavriil Xanthopoulos	Institute of Mediterranean Forest Ecosystems and Forest Products Technology in Athens
	Johann G. Goldammer Paul Hedley	Global Fire Monitoring Center Northumberland Fire and Rescue Service
	Anonymous	Italian Civil Protection Department
Industrial risks	Klaas den Haan	CONCAWE
	Francesco Geri	Italian dept. of civil protection
	Alberto Susini	Environmental enterprise compliance agency, Genevea
	Valerie Godfrin	CRC - Mines Paris Tech
	Laura Rio	UNEP

2.2.3 *Workshops*

To verify the results of the study and support the translation of GPs into minimum standards, five workshops were organised with experts from MS, academia, and international organisations[6]. Each theme was allocated a one-day workshop held in Brussels in late April – early May 2012. The workshops aimed to collect feedback on and verify the list of practices collected by peer groups. They also sought to define criteria and distinguish a "good" practice from a general practice and generate ideas on how to translate GPs into minimum standards.

The main questions for the workshop participants were as follows:

Table 2: Guiding questions for workshop discussions

Guiding questions for the workshop participants
Which practices can be highlighted as particularly good and why?
• Is there any important good practice missing from the draft list of practices?
• What distinguishes a good practice from a general practice?
• Which criteria could be used to identify a good practice?
What ideas can we distil from reviewing the good practices for translating these into minimum standards for disaster prevention?
• What should or shouldn't be included when drafting guidelines?

The workshops proved instrumental to (a) distil the GPs from the initial inventory of practices, and (b) to better understand what really makes a practice 'good'. The discussion and conclusions from all workshops therefore helped to ensure robust and commonly accepted study results before drafting guidelines for minimum standards.

2.2.4 *Post-workshop follow-up*

As a follow-up to the workshops, a comprehensive report was written on the outcomes and has been attached in Annex C. The workshop report was shared with all participants of the workshops, all experts who were invited to join the workshops but were unable to attend, and the relevant Commission working groups on disaster risk prevention, in particular from the Directorate-General for Humanitarian Aid and Civil Protection (DG ECHO) and the Directorate-General for the Environment (DG Environment). This review process has ensured thorough stakeholder involvement and robust results of the inventory, the workshops and the start of the translation of GPs into minimum standards.

First, all workshop attendants were contacted and sent written summaries of the sessions. The attendants were invited to comment and to suggest changes to the texts. In total 20 attendees took the opportunity to add comments, whereas most only gave their approval to the summary. Some provided additional texts and practices that were added to the inventory. The answers enabled the group to remove or adjust inputs to the inventory that were outdated or not considered relevant for other reasons.

Second, during the preparations for the workshops, all experts who, for whatever reason, declined the invitation were asked if they would be available to comment on the outcomes of the workshops. Most responses were positive and these people were sent the workshop summaries. The feedback from this group was very limited.

[6] The list of participants is provided in Annex C.

Finally, DG ECHO sent out the workshop outcomes and the lists of GPs to all hazard specific working-groups at EU level. These were:

- risk assessment group;
- industrial hazards group;
- floods working group;
- forest fire expert group;
- drought expert group.

A limited number of responses were received and distributed accordingly:

- industrial hazards group: Lithuania, Portugal, UNECE, Italy, France, Slovakia;
- forest fire group: Spain, Saxony, Sachsen-Anhalt, Bayern;
- risk assessment: Finland, Austria;
- floods working group: Spain.

It should be noted that during the workshops some working groups were represented. In particular Working group F on floods were given ample opportunity to express opinions and make adjustments to the inventories.

2.3 Step 1 – An inventory of good practices

Tasks 1 and 3 in the terms of reference to the study, ask the study team to make an inventory and assessment of GPs in disaster risk prevention in Europe. First of all, an inventory indicates an *exhaustive* list of all practices in disaster prevention in Europe. In close co-operation with the Commission, however, the study team deemed such a task to be beyond the scope of the project and settled with a *non-exhaustive* list that illustrates GPs in all themes. Second, the study team has engaged in a long discussion on what constitutes a practice. A practice could be a law, for example, but also the way in which a law is implemented. There are also many practices that are not defined formally, but are rather something that emerged from talking to practitioners. To accommodate the large variety of practices, the approach has been inclusive rather than exclusive, in the sense that almost all activities carried out on disaster prevention have been included in the long list.

Moreover, the project has been carried out over a period of almost two years and the list has become a living document where practices have been added and updated to the furthest extent possible. It should be highlighted that the list is a means to creating the guidelines and is not an end in itself. During the workshops in particular, the list was scrutinised by national civil contingency agencies, thematic experts from academia and research, Commission working groups, regional authorities, non-governmental organisations (NGOs) and other stakeholders. Several participants provided valuable comments on the practices, and added practices from their own thematic areas or home countries. Finally, DG ECHO presented the study team with a number of practices that fitted well with the analysis.

The study team take full responsibility for all input in the list, including data that may be incorrect and outdated. The final list contains 438 practices from over 35 countries including all countries participating in the CPM plus Turkey, Australia, New Zealand, USA and Switzerland. See Annex A for a complete overview.

Table 3: Overview of final inventory, total number of practices and expert interviews

Theme	Number of practices	Expert Interviews
Horizontal measures	74	6
Earthquakes and tsunamis	78	3
Floods and storms	107	4
Heat waves, droughts, fires	113	6
Industrial risks	66	5
TOTAL	**438**	**24**

Once a practice was identified it was described in detail in terms of:

- country of implementation;
- type of theme;
- name;
- administrative level;
- public or private;
- typology;
- descriptive summary;
- involved actors;
- timeframe of the activity;
- direct or indirect economic costs;
- indirect economic benefits on GDP;
- positive/Negative social impacts;
- positives/Negative environmental impacts;
- financing source;
- brief assessment of key features for success and minimum standards it could support.

The descriptions were made when data was available. It is clear that a detailed analysis of over 440 practices is unfeasible, given the time and resources available to the project.

2.4 Step 2 – What constitutes a good practice?

Once the inventory was prepared, it became necessary to define what makes a practice good. To solve the task, the study team combined an analysis of the provided practices in the overview with expert input from the interviews and workshops. The starting point was to attempt to assess the cost-efficiency as well as economic, environmental and social effects of a practice and the European Commission's Impact Assessment Guidelines[7] that provides a broad number of evaluation criteria commonly used in European decision-making. During the study process it became clear that only limited information was available on most practices. The study team therefore relied on a qualitative method of expert opinion from team members, interviews and workshop participants. The outcome was a long-list of selection criteria across all themes. These criteria have been divided under the headlines of: Effectiveness, Efficiency, Transferability, Sustainability, and Coherence[8].

[7] EC, 2009. Impact Assessment Guidelines. SEC(2009)92.

[8] Effectiveness, Efficiency and Coherence are based on the EC (2009) Impact Assessment Guidelines.

Table 4: Long-list of criteria for good practice selection

Criteria divided into groups
Effectiveness
Definition: the extent to which the practice reaches the objectives of the proposal
1. Good communication and co-operation between regions/cities and the national government, cross-scale aspects;
2. Demonstrable implementation success.
Efficiency
Definition: the extent to which the practice can be taken where the objectives can be reached for the least cost possible
3. Cost-effectiveness (in a qualitative way; quantitative will be impossible for most).
Transferability
Definition: the possibility of the practice to be transferred to other contexts (upscaling)
4. Ease of implementation;
5. Enabling environment (what surrounding factors have made the practice work?):
a. One characteristic of a good practice is that it is appropriate within a given context (within the overall suite of practices that if forms a part of, but also within regional characteristics).
6. Simple and clear.
Sustainability
Definition: the possibility for a practice to generate long-lasting effects.
7. Extent of uptake and involvement by all stakeholder groups;
8. Involvement of different stakeholders within decision-making:
a. Ease of comprehension and communication.
9. Continuity of support (financial and/or technical) and thus sustainability of the measure.
10. Having a learning culture - taking “lessons learned” into account;
a. Robustness.
11. Due to potential implementation difficulties, a criterion on *flexibility to change* in order to pick up potential future opportunities.
12. Public access to information.
Coherence
Definition: the extent to which options are coherent with the overarching objectives of EU policy, and the extent to which they are likely to limit trade-offs across the economic, social, and environmental domain.
13. Principle of subsidiarity;
14. Address at least one of the key challenges we face in disaster prevention today;
15. The capacity of the measure to reduce vulnerability as a whole;
16. Enhance implementation of any potential existing legislation and/or guidance;
17. Align and integrate with climate adaptation measures as fully as possible;
18. Cannot be contradictory to other environmental goals, etc.

This set of selection criteria was used to shortlist GPs from the broader inventories per theme. Based on the criteria and input from the workshops, the experts from the study team then made a selection of 5 – 8 practices from the inventory per theme that stand out as particularly good. These would be further investigated in-depth and highlight different horizontal aspects of disaster risk prevention elaborated upon in Step 3.

2.5 Step 3 – Translating good practices into minimum standards for disaster prevention

The translation of GPs into guidelines for minimum standards is perhaps the most challenging part of the project. The study team has relied largely on anecdotal evidence, expert opinion and peer-reviews. For example, selected GPs were presented to different experts to elicit second opinions in workshops and interviews.

A few criteria were set from the beginning of the project. The Commission clarified that the minimum standards will be *non-legally binding and will seek to contribute to the effective implementation of existing hazard specific EU legislation by applying a horizontal and multi-hazard approach and addressing identified gaps*. It may then be concluded that the task should be to develop guidelines for minimum standards in disaster prevention that:

- are established at EU level, targeting MS and their regional and local sectors;
- are non-legally binding;
- do not attempt to replace sectoral legislation but support implementation and fill gaps;
- apply a multi-hazard approach.

Clearly, GPs that include the above mentioned elements would be favoured. Moreover, the guidelines should focus on those areas where there is a clear EU added value. The following points were highlighted during the various workshops:

- Guidance would be most useful at the local level;
- EU guidelines should help work towards solving a problem in prevention that has been identified by several MS;
- Guidelines should be applicable in most MS;
- The resulting minimum standards should not bear unreasonable costs;
- Guidelines could be structured along the first four out of five 'Hyogo Framework for Action' (HFA) priorities for action, namely:
    - Ensure that DRR is a national and a local priority, with a strong institutional basis for implementation;
    - Identify, assess and monitor disaster risks and enhance EWS;
    - Use knowledge, innovation and education to build a culture of safety and resilience at all levels;
    - Reduce the underlying risk factors.

Once the experts at the workshops had highlighted the focal areas of the minimum standards, the study team created a list of critical topics for the development of guidelines.

2.6 Caveats in the approach

- Quantitative data on disaster prevention is scarce. The study team has instead taken a largely qualitative research approach based on expert interviews, literature reviews and workshops. The study has therefore primarily relied on expert judgement, backed up by secondary information and interview sources. This has enabled us to undertake an analysis that focuses on specific identified practices and themes, but there has been a trade-off in terms of potential data bias and coverage of practices;
- The reliance on anecdotal data is susceptible to bias of different kinds. Wherever possible we have tried to accomplish data triangulation and confirm our approach, results and data with several sources. There remains a possibility of bias, based on information received and how we interpreted the perspectives provided;

- The coverage of GPs was intended to be illustrative and not comprehensive. We have tried to identify examples of GPs across countries, sectors and themes, but the listing should not be seen as an attempt to be exhaustive. Indeed, the study team has been highly dependent on input from MS. Some MS have been more active than others in providing data, which may have led to a selection bias;
- The study team has focused strongly on EU practices, however DRR is a global issue and even more so in disaster prone areas. Some countries, such as Japan and Australia, are likely to have more experience and potentially better practices due to the frequency of events, compared to many European countries. Even though some non-EU practices have been included in the study, the study may have benefited from a larger coverage. Of course, this would have required considerably more resources and was therefore not part of the research scope;
- Finally, while the good practices cover a large cross-section of hazards, the scope of the report did not allow for an exhaustive list of hazards. In particular, nuclear accidents were not considered for the purpose of this report; however, this is not to imply that there are no good practices in this area or that this and other hazards could not be covered by future work on good practice.

3 Non-exhaustive inventory of good practice per hazard type

This chapter offers a brief introductory section to the peculiarities of each hazard type and then focuses on presenting the results from collecting the non-exhaustive inventory of prevention practices. The last section offers a tabular overview of the consequent selection of what are considered the 'good practices' (GP) based on the selection criteria defined in Section 2.4.

3.1 An introduction to major hazard types facing Europe

This section provides a summarised overview of the major trends and peculiarities of each hazard type. It offers some basic information per hazard type that is necessary to have in mind when reading the consecutive chapters analysing the GP collection and draft guidelines from a multi-hazard perspective. Though not technically a particular hazard type, horizontal practices are also briefly introduced to better explain their meaning. This horizontal viewpoint allowed for the inventory of practices to also capture those measures that cannot be assigned to one single hazard type.

3.1.1 Horizontal measures cutting across hazards

Horizontal measures (HM) are practices that apply across different types of hazards, which are geared towards the general enhancement of disaster risk management (DRM), rather than a focus on specific types of impacts. In the terms employed in this study, we use the following definition for '**horizontal measures**': *Horizontal measures are understood as multi-sectoral and/or multi-hazard measures and practices. Essentially, these are crosscutting actions designed to apply to hazards in general and which are likely to involve a range of actors.*

HMs applied in European countries tend to comprise of the following:

- general DRM governance and capacity development;
- legislation, policies and strategies, spatial planning;
- information systems (including multi-hazard risk assessment processes and warning systems);
- education and awareness raising, advocacy and networking;
- financial instruments, including insurance and re-insurance.

Potentially they can include technological measures (e.g. hazard monitoring), but few structural mitigation measures could fall under this category since they tend to be hazard-specific. Nevertheless, the scope of HMs remains large and practical experience in key measures, such as structures and policies for governance of DRM, shows considerable variation between European countries.

One of the key challenges in governance, as well as in educational work, has been to shift the focus from activities that are oriented toward coping with the emergency phase, toward activities that truly relate to prevention, mitigation and sustainable recovery. As the European report to the Hyogo Framework for Action (HFA) notes, attaining the core aims of disaster risk reduction (DRR) for vulnerable populations still tends to be the most challenging aspect, in terms of reducing the underlying risk factors that can potentially generate disaster situations. That is the core task for prevention.

Another principal challenge in horizontal working is to develop a multi-hazard approach. Increasingly, it is recognised that improvements in effectiveness and efficiency are gained when using an integrated, multi-hazard approach, based on the assessment of risks from different forms of potential hazards. Part of the rationale for this is that certain DRM approaches and practices should be applicable to all hazard types, and need not be replicated wholesale. However, the rationale for multi-hazard approaches is also that, unless analysis is done across different types of hazards, then efforts made to manage the effects of one may be negated by, or even exacerbate, the effects of other extreme events (including the impacts of long-term climate change). Multi-hazard approaches may not be applicable for all types of activity, but where feasible and appropriate they should form the basis of intervention.

Along with working across hazard types, another key challenge for DRM is to work across institutions, sectors and scales. Given the multi-sectoral and multi-scale implications of disaster events, an integrated system of DRM in all aspects is the ideal model. However, full integration is a major challenge given that legislation relating to DRM itself tends to be quite diffused. Nevertheless, a number of the examples of GP featured in the inventory work towards the co-ordination of institutions, policies, plans, information systems, capacity building and financial mechanisms. Moreover, at the European Union (EU) level, the Commission is implementing a series of initiatives to support HMs in DRM, including guidelines for national risk assessment and increased regional funding for DRM.

3.1.2 Floods and storms

Floods and severe storms represent two of the most widespread hazards in Europe, which will be exacerbated by climate change.

As reported by the European Environment Agency (EEA)[9], between 1998 and 2009, Europe faced over 213 major floods that caused significant damage and a total of more than 1000 people killed. Among the events resulting in the largest overall economic losses were the floods in Central Europe (2002, losses of over EUR 20 billion), in Italy, France and the Swiss Alps (2000, losses of about EUR 12 billion) and in the United Kingdom (2007, losses of over EUR 4 billion). Even though floods are a common phenomenon in Europe, the nature of the hazard events that generate flood risk can be very different. While central Europe mainly suffers from floods stemming from large transnational rivers (e.g. Danube), Mediterranean countries - particularly Spain, France, and Italy - have higher levels of risk of experiencing flash floods. As a result of these diverse sources of risk, national and local coping policies have developed in very different directions across Europe. Nevertheless, flood risk management and prevention initiatives have been set up on a European level, namely Directive 2007/60/EC on the assessment and management of flood risks, which entered into force on 26 November 2007, triggering intense activity both at European and national levels on flood risk management.

According to the Commission's communication on flood risk management from 2004[10], prevention is considered to be actions that are aimed at preventing damage caused by floods, by avoiding the construction of houses and industries in known present and future flood-prone areas, by adapting future developments to the risk of flooding and by promoting appropriate land-use, agricultural and forestry practices. Therefore, the prevention measures according to this definition focus mainly on vulnerability and exposure, and in minimal part on the hazard itself through seeking to reduce the

[9] EEA, 2011. Mapping the impacts of natural hazards and technological accidents in Europe: An overview of the last decade. EEA Technical report No 13/2010. (http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural).

[10] EC, 2004. Flood risk management Flood prevention, protection and mitigation COM(2004) 472final of 12.7.2004.

runoff contribution during events. From an operational point of view, one can say that flood risk management aims to reduce the likelihood and/or the impacts of floods. In particular, the European Floods Directive (2007/60/EC) (EFD) already represents a minimum standard in terms of preventive action and flood risk management to be fulfilled by EU Member States (MS). Their requirements are as follows:

- By 2011 to carry out a preliminary assessment to identify the river basins and associated coastal areas at risk of flooding;
- By 2013 to draw up flood risk maps for such zones defined above;
- By 2015 to establish flood risk management plans focused on prevention, protection and preparedness.

To this end, and as a support structure for the implementation of the EFD, Working Group F on Floods (WG-F)[11] was initiated. As stated in the Work Programme 2010-2012 of the Common Implementation Strategy for the Water Framework Directive (2000/60/EC) (WFD), the purpose of WG-F is to:

> "[…] provide a forum for support for the implementation of the Floods Directive, for information exchange between Member States and stakeholders on good practices with a view to reaching a common understanding on the requirements for the implementation of the Floods Directive, and for linking with other related activities in the CIS and at EU level for support of the implementation".

As already stated, the EFD defines the minimum standards for flood risk management. Therefore, this current study primarily considered the outcomes of WG-F to be GP examples, although other GPs in prevention and protection measures were also taken into account. An overview of all relevant documents and information provided by WG-F is already available on the website for the Communication & Information Resource Centre Administrator (CIRCA)[12] for the EU.

Storms were the costliest natural hazard in Europe, in terms of insured losses, in the period between 1998 and 2009 and generated more than 700 fatalities. According to the EEA[9], the most significant storm events were storms Lothar and Martin in late December 1999 and Kyrill in January 2007. Overall these storms were responsible for about 200 deaths and economic losses amounted to EUR 22.7 billion. Despite this there is so far no specific policy in place at the EU level for storm risk management and prevention initiatives.

3.1.3 Earthquakes and tsunamis

Earthquakes represent one of the most dreaded hazards, because they happen unexpectedly and are very difficult to forecast. Their occurrence simultaneously affects people across a large region. For this reason, people and mass media ascribe great importance to earthquake prediction. Unfortunately, the cases of the recent destructive earthquakes that have occurred with imposing frequency in Sichuan (China, 2008), Italy (2009), Haiti (2010), Chile (2010), New Zealand (2010) and Tohoku (Japan, 2011) have shown that, in the present state, seismological research[13] can do almost nothing in the implementation of short- and medium-term earthquake forecasts, which would

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[11] The Working group F on Floods has been established by the Directorate General of the Environment (DG Environment) as part of the Work programme of the Common Implementation Strategy 2007-2009, consisting of MS representative, it is with the objective of exchanging information on various issues in relation to flood risk management at the EU level and to the implementation in MS of the EU Floods Directive.

[12] http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents/management_finalpdf/_EN_1.0_&a=d.

[13] Recent publications (see e.g. Console, Yamaoka, and Zhuang, Editors, International Journal of Seismology, 2012, and Tiampo and Shcherbakov, Tectonophysics, 2012) have dealt with the progress achieved in the last ten years on earthquake forecasts.

be useful for DRM. A problem of practical implementation of earthquake forecasting is the lack of a common understanding and exchange of information between the scientific community and governmental authorities that are responsible for DRM in each country: they operate in two different environments, they aim to fulfil different tasks, and they generally speak two different languages. In particular, the way in which seismologists should formulate their forecasts and how they should transfer them to decision-makers and to the public is still a tricky issue. It is clear that the formulation of probabilistic earthquake forecasts with large uncertainties in space and time and very low probability levels would be difficult for decision-makers to rely on. A new term, "operational earthquake forecasting", has been given to the process of providing usable information on future earthquakes or ongoing seismic sequences. The Italian Civil Protection Agency appointed the International Committee to write an extensive report on the potential of such a process.[14]

On the other hand, useful steps have been made for mitigating earthquake disasters. Seismic risk can be defined by the expected costs that a community will pay to recover damages caused by earthquakes. It is widely recognised that seismic risk is the product of three factors: natural hazard, vulnerability and exposure. Natural seismicity cannot be modified, and therefore prevention measures can only focus on disaster preparedness and the reduction of vulnerability, instead of the reduction of the hazard factor. With this perspective in mind, mitigation of seismic risk may require a different approach as compared to other hazard themes. Another important aspect of seismic risk is that it is strongly variable from country to country, so that earthquake DRM needs to be studied with differentiated regional criteria.

While it is commonly perceived that tsunamis represent the greatest risks in low-lying developing countries, such as in the case of the 2004 tsunami striking Indonesia and Thailand with more than 300 000 people killed, the tsunami phenomenon actually poses a real risk in Europe also. The Mediterranean coast in particular, with millions of inhabitants, is considered to be more vulnerable than the Indian Ocean[15]. Currently, tsunami early warning systems (EWS) in Europe are not yet operational. Estimating the occurrence probability of natural disasters is critical for informing DRM processes related to tsunamis, such as setting construction standards. A recent study[16] has developed a methodology for probabilistic forecasting which allows for the identification of a tsunami hazard at any given location and the investigation of the potential for issuing timely tsunami warnings. The study determined that the probability of a tsunami wave exceeding 1m somewhere in the Mediterranean in the next 30 years is close to 100%. This underlines the urgent need for a tsunami EWS in the region.

3.1.4 Heatwaves, droughts and forest fires

This theme deals with disasters triggered by extreme dryness and high temperatures that can combine to produce drought[17], heat waves[18] or forest fire events[19].

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14 Jordan, T. H., Y.-T. Chen, P. Gasparini et al. 2011, Operational earthquake forecasting. State of knowledge and guidelines for utilization, Annals of Geophysics, vol. 54, article 4.

15 International Federation of Red Cross and Red Crescent Societies. World Disasters Report 2009.

16 Sørensen et al., Probabilistic tsunami hazard in the Mediterranean sea, Journal of Geophysical Research, 2012.

17 Drought is a natural phenomenon, which is defined as the sustained and extensive occurrence of below-average water availability, caused by climate variability. Droughts may refer to meteorological drought (precipitation well below average), hydrological drought (low river flows, lake and groundwater levels), agricultural drought (soil moisture deficit), and socio-economic drought (the impact on economic goods and services).

18 Heat waves can be defined as extreme temperature events in the inter-annual temperature, resulting in hot/warm spells or tropical nights. According to the International Disaster Databse (EM-DAT), a hot/warm spell or heat wave is a prolonged period of excessively hot, and sometimes also humid, weather relative to normal climate patterns of a certain region. Due to the fact that the term is relative to the usual weather conditions in a given area, there is no universal definition of a heat wave, e.g. a temperature threshold that has to be reached for a number of consecutive days. This is manifested in the

Heat waves are becoming more common across Europe in recent years causing high death tolls. Similarly, droughts have increased dramatically in number and intensity causing losses in billions of Euros to the economy[20]. In addition to direct damages to people and goods, heat waves and droughts are often the indirect cause of severe forest fires.

Heat waves, droughts and forest fires are weather related risks, therefore, using meteorological forecasts, it is possible to predict their potential magnitude. Heat waves, droughts and forest fires are recurrent in time and in some areas they are very frequent. The use of EWS and communication activities can mitigate heat wave and drought damages. However, the main aspect characterising forest fires, at least in the Mediterranean basin, is that they are often man-made and therefore unpredictable.

Heat wave and drought risk (DR) management can be implemented through the improvement of heat wave and drought knowledge, early warning systems, the reduction of vulnerability and exposure and improving information distribution and awareness to the affected population. The identification of high-risk prone areas is a fundamental step in understanding where it is necessary to adopt prevention activities, in order to reduce the number of victims and damage in the case of these events. The hazard level of a specific territory related to heat waves, droughts and forest fires, is represented by the existing fuel (in the case of fires), and the frequency and magnitude of the considered event. In the cases of heat waves and droughts, magnitude is related to the maximum air temperature and the deficiency of precipitation, respectively, over an extended period of time and within a given area. Hazard in the case of forest fires is related to ignition probability and the physical characteristics of the fire front, the fireline intensity (fuel content) and the rate of spread.

Heat Waves

In the period 2000-2010, heat waves have been the deadliest weather-related extreme. In total, more than 70 000 excess deaths attributed to the weather extreme were reported in western and central Europe in the hot summer of 2003[21]. Heat waves were also responsible for many fatalities in the summer of 2006 in Western Europe and in the summer of 2007 in (South-) Eastern Europe.

Climate change is likely to influence the frequency and intensity of extreme temperature events. High-temperature extremes like hot days, tropical nights and heat waves have already become more frequent[22] [23] [24]. Extreme high-temperature events across Europe are projected to become more frequent, more intense and to last longer[25] [26] [27] [28].

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heterogeneity of thresholds defined in the different EU MS in order to issue heat wave warnings (see the different GPs regarding heat wave EWS in the inventory).

19 This section relies on the synthesis provided by EEA (Mapping the impacts of natural hazards and technological accidents in Europe - Technical report No 13/2010, EEA (European Environment Agency), Jan 12, 2011).

20 EU action against climate change: Adapting to climate change, 2008.

21 Robine, J.M., S.L Cheung, S. Le Roy, H. Van Oyen, F.R. Herrmann, 2007. Report on excess mortality in Europe during summer 2003. In: G. A. EU Community Action Programme for Public Health. AND Robine, J.-M., S. L. K. Cheung, S. Le Roy, H. Van Oyen, C. Griffiths, J.-P Michel. & F. R. Herrmann (2008) Death toll exceeded 70,000 in Europe during the summer of 2003. Comptes Rendus Biologies, 331(2), 171–178.

22 ECA&D, 2010. European Climate Assessment & Dataset (ECA&D). http://ecad.knmi.nl/ (accessed 10 November 2010).

23 IPCC, 2007a. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Solomon, S.; Qin, D.; Manning, M.; Chen, Z.; Marquis, M.; Averyt, K. B.; Tignor M. and Miller H. L. (eds.), Cambridge University Press, Cambridge, the United Kingdom.

24 IPCC, 2012: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.* A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

25 Tebaldi, C.; Hayhoe, K.; Arblaster, J. M. and Meehl, G. A., 2006. 'Going to the extremes: an intercomparison of model-simulated historical and future changes in extreme events', Climatic Change, 79: 185–211.

Preventive options for reducing the direct impact of extreme temperature events should focus on information and preparedness associated with early warning, since fatalities due to extreme temperature events are thought to be largely preventable[29]. Prevention in the long term must ensure that the vulnerability of the population and relevant infrastructure are reduced by improving urban planning and architecture (e.g. increasing the canopy cover in urban areas) as well as through energy and transport policies. Strategies are needed to reduce the heat exposure of individuals and communities (especially vulnerable populations), to plan health and social services and infrastructure, and to provide timely information to the population (these last measures are largely represented in the selected GPs).

Droughts

Over the last three decades the occurrence of drought in terms of area and population affected has been increasing[30] and as a consequence, so has the economic impact of drought events[31].

Drought should not be confused with aridity, which is a long-term average feature of a dry climate. Likewise, drought should not be confused with water scarcity, which reflects conditions of long-term imbalances between water availability and demands[32] [33] [34]. Droughts can affect both high and low rainfall areas of Europe and can develop over short periods of weeks and months or much longer periods of several seasons, years and even decades. In many cases droughts develop gradually, making them difficult to identify and predict[35] [32] [36].

There is growing evidence of changes in the global hydrological cycle over the last 50 years that may be linked with changes in climate, such as increasing continental runoff, a wetter northern Europe and a drier Mediterranean. Long-term trends in hydrological variables, however, are often masked by significant inter-annual to decadal variability[37] [38].

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26 IPCC, 2007b. Climate Change 2007: Impacts, Adaptation and Vulnerability. Working Group II contribution to the IPCC Fourth Assessment Report.Parry M.L., Canziani, O.F., Palutikof, J.P, van der Linden P.J, and Hanson, C.E. (eds) Cambridge University Press, Cambridge United Kingdom and New York, NY, USA.

27 Beniston, M.; Stephenson, D.B.; Christensen, O.B.; Ferro, C.A.; Frei, C.; Goyette, S.; Halsnaes, K.; Holt, T.; Jylhü, K.; Koffi, B.; Palutikoff, J.; Schöll, R.; Semmler, T. and Woth, K., 2007. 'Future extreme events in European climate: An exploration of regional climate model projections', Climatic Change, 81:71–95.

28 Van der Linden, P. and Mitchell, J.F.B. (eds)., 2009. ENSEMBLES: Climate Change and its Impacts: Summary of research and results from the ENSEMBLES project. Met Office Hadley Centre, FitzRoy Road, Exeter EX1 3PB, the United Kingdom. 160 pp.

29 EuroHEAT-project for heat waves; WHO, 2009.

30 Member States data, EC, 2006.

31 Member States data, EC, 2006.

32 Tallaksen, L.M. and van Lanen, H.A.J. (Eds.) 2004. Hydrological Drought. Processes and Estimation Methods for Streamflow and Groundwater. Developments in Water Science, 48, Elsevier Science B.V., 579 pp.

33 EC, 2007a. Addressing the challenge of water scarcity and droughts in the European Union. Communication from the Commission to the European Parliament and the Council. COM(2007) 414 final, 18 July 2007.

34 van Lanen, H.A.J. & Tallaksen, L.M., 2007a. Hydrological drought, climate variability and change. In: Heinonen, M. (Ed.). Climate and Water. Proc. of the third Int. Conf. on Climate and Water, Helsinki, Finland, 3–6 September 2007, 488–493.

35 Wilhite, D. A. (Ed.) (2000). DROUGHT A Global Assesment, Vol I &II, Routledge Hazards and Disasters Series, Routledge, London.

36 EEA-JRC-WHO, 2008. Impacts of Europe's changing climate 2008 indicator-based assessment. Joint EEA/ JRC/WHO Report; EEA Report No 4/2008.

37 Bates, B. C.; Kundzewicz, Z.W.; Wu, S.; & Palutikof, J. P., 2008. Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat. Geneva. 210 pp.

38 van Lanen, H.A.J.; Tallaksen, L.M. and Rees, G. 2007b. Droughts and climate change. In: Commission Staff Working Document Impact Assessment (SEC (2007) 993), Accompanying document to Communication Addressing the challenge of water scarcity and droughts in the European Union (COM(2007) 414), Commission of the European Communities, Brussels, Belgium.

In 2007 the European Commission adopted a Communication on Water Scarcity & Droughts[39], which specifies the measures needed if Europe is to move towards a water-efficient and water-saving economy. These include full implementation of the WFD, water pricing, moving towards sustainable land-use planning, giving priority to water savings and water efficiency measures over other alternatives and further integrating water issues into all sectoral policies. Adaptation to climate change will add a further challenge.

Drought management is an essential element of water resource policy and strategies. Drought Management Plans (DMPs)[40], based on the characterisation of possible droughts in a basin, their effect and possible mitigation measures, should be prepared on a river basin scale and before they are needed. By promoting sustainable water use, DMPs are closely linked with the WFD objectives.

Forest Fires

The high heterogeneity in climate, weather conditions, vegetation cover, land use and topography makes Europe vulnerable to forest fires both in the summer and in the winter. In particular, mountainous regions are predominantly characterised by winter fire patterns, mainly due to frequent and extremely dry winds from the north, while the southern regions and the large islands are characterised by severe summer fire patterns, because of the higher temperatures and prolonged lack of precipitation.

As reported by the EEA[41], in the period 1998-2009 an average of 70 000 fires took place every year, burning more than half a million hectares of the forested areas in Europe. However, the average value is not representative of the fire regime in the various European countries. Most of the burned area (85% of the total burned area) is concentrated in the Mediterranean region[42].

Experts have highlighted an increase in prevention activities in recent years and better organisation of forest fire services, with an ever-increasing deployment of manpower and vehicles that has led to a rapid change in the effects of forest fires throughout Europe. It should be emphasised, however, that the relatively high number of water bombers and the increased efficiency of fire extinguishing operations were not sufficient to contain the catastrophic effects of the 2003, 2005 and 2007 summer fire seasons, when the total burned area reached the highest value of the past 40 years in Portugal, Spain, Italy and Greece, causing many casualties. The events of these summer seasons further emphasised how forest fires not only cause damage to forests, but can often turn into real civil protection emergencies, like other natural hazards. Due to the ever-growing interface between rural and urban or recreational areas, the propagation of fire increasingly affects people, infrastructures and productive activities.

Forest fires, along with other natural disturbances such as landslides, avalanches, earthquakes, and floods, are characterised by a large number of low-intensity events (which have little impact on society) and a small number of catastrophic events (which have severe impact on society). Almost all the various fire patterns characterising different eco-regions are associated with a limited number of fires that burn most of the total burned area[43] [44]. To be able to predict less than 1% of

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39 EC, 2007a. Addressing the challenge of water scarcity and droughts in the European Union. Communication from the Commission to the European Parliament and the Council. COM (2007) 414 final, 18 July 2007.

40 EC, 2007b. Drought Management Plan Report, Including Agricultural, Drought Indicators and Climate Change Aspects, Water Scarcity and Droughts Expert Network, Technical Report - 2008 – 023, Office for Official Publications of the European Communities, Luxembourg.

41 Mapping the impacts of natural hazards and technological accidents in Europe - Technical report No 13/2010, EEA (European Environment Agency), Jan 12, 2011.

42 EFFIS, 2010.

43 Strauss, D., Bednar, L., Mees, R. 1989. Do one percent of the forest fires cause ninety-nine percent of the damage? Forest Science 35: 319–328.

forest fires mean reducing the total burned area by more than 90%. For this reason, it is essential that the most affected European countries adopt prevention protocols based on EWS that are able to predict these extreme conditions. Monitoring and patrolling can be very effective in ignition probability reduction. In severe meteorological conditions, the best way to fight a fire is to avoid its ignition. Furthermore, preventive activities are comparatively cheaper than fire fighting activities.

To this end, the Commission's Joint Research Centre manages the European Forest Fire Information System (EFFIS) and publishes the Canadian Fire Weather Index on a daily basis. In addition, many countries adopt a national Fire Danger Index developed at a local scale.

DRM for forest fires involves promoting activities aimed at reducing the causes of ignition, adopting forecast tools and defining operating protocols for prevention activities intended to prevent fires, to mitigate the consequences of the fire spreading and to improve the efficiency of fire extinguishing activities. However, emphasis also needs to be placed on conserving the vegetation cover, mapping the actual fire risk and adopting policies that enable planning a shift in vegetation cover based on a cost-benefit analysis that considers the interaction between land use/land cover and natural disturbance.

3.1.5 Industrial hazards

The Major Accident Reporting System (MARS) database[45] holds records of about 750 accidents that occurred in the European Economic Area (EEA) member countries between 1984 and 2009. 339 industrial incidents occurred from 1998 to 2009 and of these, 262 were considered to be major accidents, with the criteria for an accident to be regarded as a major industrial accident and reported under this obligation being defined in Annex VI of the Seveso II Directive 96/82/EC as amended by 2003/105/EC on the prevention and mitigation of major industrial accidents[46]. Additionally, there were a number of serious transport-related accidents. In total, technological accidents claimed about 169 lives during the period. In contrast, in the same period there were only 22 incidents that had impacts on the environment.

The number of accidents registered by MARS in EU-15 and in the European Economic Area show that before 1998 the number of industrial accidents was increasing steadily every year, but has been decreasing since 2000. The accidents do not present any specific spatial trends of clustering. Since 2000, while the number of establishments has been increasing, the number of accidents per site has been on a downward trend. [47] Analysis of accident reports over recent years indicates some significant causal factors. Among these factors it is worth mentioning the following: there were an increasing trend of major accident triggered by maintenance; many major accidents involved loading/unloading operations or were initiated by intermediate storage; some accidents that had limited impacts in terms of consequences outside the installation still caused fatalities on site.

In recent years, some accidents categorised as transport accidents (and thus not included in the scope of the Seveso Directive) involved hazardous substances that are regulated by the Directive. Some examples include the explosion of LPG road tankers in Montluel/Dagneux (France) in May 2007 and the explosion of rail tankers in Viareggio (Italy) in June 2009. Another area not covered

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44 Schoenberg, F.P., Peng, R., Woods, J. 2003. On the distribution of wildfire sizes. Environmetrics 14(6): 583–592.

45 http://mahb.jrc.it/index.php?id=39.

46 It should be noted here that on 4 July 2012, the Directive 2012/18/EU was adopted (Seveso III) which, while entered into force on 13 August 2012, will replace the Seveso II Directive by 1 June 2015.

47 http://ec.europa.eu/environment/seveso/pdf/report_2006_2008_en.pdf.

by the Seveso Directive but which nevertheless poses a major industrial-related accident risk concerns pipelines outside establishments. There was a serious accident of this type in Ghislenghien (Belgium) in July 2004.

The magnitude of industrial accidents in terms of economic losses and environmental impact is difficult to assess with the current data available. However the known costs associated with the events in the period 1998–2009 was at least about EUR 3.7 billion[48]. Similarly, the record of major accidents shows few have ecological impact (22 in the period 2003–2009)[49]. In recent years, there have been no reported incidents of large releases of toxic gas or widespread discharge into the water system of toxic liquids with long-term impacts. Natural-hazard triggered technological accidents (NATECH), such as those caused by earthquakes, floods and forest fires, require special attention and analysis. Such accidents are likely to experience increases in occurrence due to increasing frequency of extreme natural events and increased complexity and interdependencies of industrial systems.

The risk of industrial accidents remains an issue and thus needs to be managed accordingly. This is because many sites with major accident potential are situated in densely populated areas, with limited risk mitigation opportunities such as relocation to safer neighbourhoods. Spatial planning, including the appropriate separation of industry, infrastructure and residential settlements in industrial areas, offers an effective mechanism for risk mitigation and is a key prevention factor to include in an integrated risk management approach. DRM for industrial hazards, in particular major accidents in the European chemical industry, is highly regulated by a number of legislative instruments, namely the Seveso Directives. Following the Seveso accident in 1976, the first EU Directive 82/501/EEC, known as Seveso I Directive, was adopted in 1982, replaced by the second Seveso Directive 96/82/EC in 1996 (Seveso II), and successively extended to include the storage of chemicals and chemicals not included in the former Directive, by Directive 2003/105/EC. The aims of the Seveso II Directive are twofold - the prevention of major-accident hazards involving dangerous substances and the limitation of the consequences of such accidents. In accordance with the Seveso II Directive, all operators of an establishment where dangerous substances are present above a certain (upper-tier) threshold should adopt a safety report, a safety management system and an emergency plan, while competent authorities should develop land use planning and incorporate processes for accident reporting and inspections. Both operators and competent authorities have the obligation to inform and consult the public.

The Seveso Directive has been modified, implemented by MS and adapted over the years and a review of the Seveso II Directive 96/82/EC has been concluded. As a result, the Seveso III Directive 2012/18/EU has been adopted on 4 July 2012. It will replace Seveso II as from 1 June 2015. The main changes are:

- To align Annex I of the Directive (defining the substances falling within its scope) with the new international chemical's classification, which has been transposed into EU law by (EC) N° 1272/2008;
- To strengthen the provisions relating to public access to safety information, participation in decision-making and access to justice, and improve the way information is collected, managed, made available and shared;
- To introduce stricter standards for inspections of installations to ensure the effective implementation and enforcement of safety rules.

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[48] EEA, 2011. Mapping the impacts of natural hazards and technological accidents in Europe: An overview of the last decade. EEA Technical report No 13/2010. (http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural).

[49] EEA, 2011. Mapping the impacts of natural hazards and technological accidents in Europe: An overview of the last decade. EEA Technical report No 13/2010. (http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural).

Seveso Directives I and II are a perfect example of how legislation gradually enforced the importance of implementing preventive safety practices such as inspections. Whereas the Seveso I Directive only contained one small paragraph on inspections, the provision in the Seveso II Directive has been extended to become an Article of its own. An attempt is made to ensure an improved consistency in enforcement at the European level through greater prescriptive detail of the obligations of the Competent Authorities. Under the Seveso II Directive, Competent Authorities are obliged to organise an Inspection System, which shall ensure that the Operator has taken all necessary measures with regards to the prevention of major accidents and the limitation of their consequences, specifically that the Safety report is correct and complete and that the public has been informed. The recently adopted Seveso III Directive (2012/18/EU) introduces even stricter standards for inspections of installations to ensure the effective implementation and enforcement of safety rules.

3.2 Brief overview of the collected initial inventory of practices per hazard type

This section provides a synthesised overview of the collected initial inventory of practices per hazard type. The intention is to provide a general idea of the types of practices that have been entered into the inventory prior to highlighting a selection of particularly interesting GPs. Actually, the inventory should be viewed therefore as a set of examples, in effect a scoping of 'candidate' GPs across Europe. From this long list, a short list of GPs was chosen and feature in the remainder of this report as illustrative examples.

3.2.1 Horizontal measures cutting across hazard types

There are many HMs in place across Europe, and it is important to recognise that this study's inventory of HMs could not cover them in a comprehensive manner. In total, 74 practices were listed in the inventory, most of them from a wide range of EU countries, plus a few external examples. We sought to provide examples of measures that can, or do, refer to multiple sources of risk and that are explicitly connected with disaster prevention (i.e. not measures specifically oriented to preparedness for emergency response).

We identified 27 practices within Europe, broadly relating to management, institutions, policies, regulations, and funding. These included measures such as a pro-active approach to DRM or climate change adaptation strategies and programmes, active prevention mechanisms built into planning procedures, indications of innovative or dedicated funding and co-ordinating institutions, including National Platforms, for DRR.

A total of 29 practices within Europe were identified that relate to the generation and dissemination of information relating to disaster risk and prevention. These include measures such as integrated mechanisms for risk assessment (e.g. going beyond hazard exposure alone to the analyses of dimensions of vulnerability), effective measures for raising awareness and education on disaster prevention and effective services to translate meteorological and hydrological forecasts into warning communications.

We listed 12 practices within Europe relating to insurance and re-insurance mechanisms. These included examples of compulsory and non-compulsory insurance, insurance provided by private companies or public/Government or by private & public/Government partnerships, and insurance mechanisms that have multi-hazard coverage.

3.2.2 *Floods and storms*

The collection of prevention practices produced an initial inventory of over 100 practices across Europe for the floods and storms theme. Organisational and informational measures dominate the list of practices, with some practices overlapping across themes. In general, the collected practices can be divided into dealing with integration, division of responsibility and raising awareness.

First, integration between policies, issues, and impacts is repeatedly mentioned as central. Several practices that focus on the creation of flood resilient cities (FL3, FL11, and FL15) were listed. These rely upon local, regional and national co-operation to cope with the pressure of an increasing influx of citizens (i.e. building more houses), while expecting more problems with future floods and storms. A complete analysis of the system of flood risk prediction, prevention, mitigation and reparation, such as that reported in FL87 helps in defining the key participants and processes in flood prevention and management. This represents the ideal starting point for integrating the existing measures in an efficient way.

Local prevention policies (FL63 and FL31) also qualify in this category as flood-warning systems are combined with actions to improve the affected inhabitants' knowledge and awareness, and the preparation of local flood mitigation plans in small towns. The integration of policies could also address the multi-facetted area of flood prevention, where environmental impacts are considered alongside health and economic issues.

A second group of practices focuses on enhancing clear distinctions of authority and responsibility. Ultimately, the implementation of any new practice relies on the competency and capacity of relevant authorities and clear guidelines that improve their decision-making process. In Ireland for example, the review of the national flood policy (FL56), focuses on designating roles and responsibilities of various stakeholders for future management of flood prevention.

Third, raising awareness helps to support positive social behaviour by citizens. In Poland for example, education in schools (FL69) was considered an important aspect. The practice includes the preparation of materials for teachers to use in their classrooms, with information and testing geared towards children. Nevertheless, the practice should be carried out in parallel with other Polish practices that support flood risk prevention on a local scale, such as early warning systems for local communities and broader education initiatives to local authorities, fire departments, and crisis management centres.

3.2.3 *Earthquakes and tsunamis*

The collected practices for the earthquake and tsunami category primarily represent structural measures for DRM. These practices can be grouped into tools for hazard mapping, micro-zoning, seismic design codes and early warning systems for tsunamis.

Hazard mapping has been recognised as an important first step for the design of earthquake resistant structures. Many well-known international criteria and standards already exist; therefore these could be used as a criterion to assess the situation in each country. Some countries (Greece, Italy, Turkey) have already taken into account international best practices (such as those existing in Japan, California, New Zealand) to develop and/or adjust their building codes.

Micro-zoning is an earthquake prevention practice, which has been developed since the 1960s starting predominantly in New Zealand and Italy. However, contrary to hazard mapping, quality international standardisation currently does not exist. This can mainly be attributed to the fact that there are too many different factors to consider, even within one country. If micro-zoning is to be

turned into a truly useful prevention measure from a practical point of view, then parameters, methodologies and technologies should be standardised internationally. Japan currently offers a good example of a private company research project on micro-zoning that also includes research from Turkey.

In order to counteract building vulnerability, practices centering on seismic design codes have been included. Italy, Greece, and Turkey, for example, all have building codes that can be considered good practice cases.

Not many examples exist of measures against tsunami risk in Europe (some of them come from Turkey, Portugal and Italy). This paucity is partly due to the fact that tsunamis may affect only the European coasts that face seismogenic structures beneath the sea. It is well known that, besides the construction of very expensive barriers along the coasts, the main practice to protect the population from tsunamis is based on early warning systems. A recent study[50] on tsunami risk in the Mediterranean region performed by a European team has shown that tsunamis, although their occurrence is much more seldom than that of earthquakes, may still constitute a significant risk for the Mediterranean coasts.

3.2.4 Heatwaves, droughts and forest fires

Overall 107 prevention practices for heatwaves, droughts and forest fires were collected and further subdivided into separate categories to facilitate overview and analysis. Organisational and informational measures dominate the list of practices with some practices overlapping the themes.

Three trends have been observed across entries. First, DMPs were considered central to improving drought management in MS. The possibility of aligning them with the River Basin Management Plans was considered essential to avoid overlaps and/or conflicting policy goals. Since no new legislation particular to drought is foreseen, the best possible way forward is most likely to be the use of water scarcity legislation and water instruments such as the WFD. Minimum standards on disaster prevention should therefore promote the design and implementation of DMPs. Second, public participation is often missing (in alerting, fire fighting, etc.) when designing and implementing policy. Involving people was considered to be crucial because not only are people affected by these events, they sometimes contribute to the cause as well. Third, mapping and assessments of risks, hazards and vulnerabilities also receive much attention. Common definitions and harmonisation of key concepts may help with information sharing and data collection.

Moreover, the missing element in current legislative frameworks is implementation. As an example, Romania has a good DMP, which was very costly to develop, but has not been adopted by the various Ministries. They also invested EUR 250 million for flood risk maps but in general such projects are too expensive. The authorities lack the funding required to put the plans into practice and maybe the use of cohesion funding could be considered for allocating the necessary finances. In a comparative case, Romania developed strategies for regional waste, but by the time they had finished this process, the funding period was over and there was no more money to be allocated for implementing the project. Similarly, the funding problem could play out across boundaries, such as in the case of the Danube basin, where regions along the northern parts of the river are able to fund drought mitigation measures whereas the southern parts lack funding.

[50] Sørensen et al., 2012. Probabilistic tsunami hazard in the Mediterranean sea, Journal of Geophysical Research.

Looking specifically at organisational, information and structural issues, the following issues have been highlighted across the collected practices. First, on organisational issues, reimbursements for damages caused by forest fires, droughts and heatwaves are important. The overall picture is that national systems for reimbursements appear to be diverged and strong laws for private ownership require a multi-stakeholder approach to arrive at a common solution. A key issue is the assessment of costs and damages. In the case of forest fires the problem is even more complex as there are three types of costs: property damages, destroyed forests, and costs to extinguish the fire. The key questions are, who is prepared to insure what and to what costs. Second, some practices highlight the harmonisation of data collection and data sharing. If cross-border and cross-regional information gathering efforts can be made, then mitigation efforts can be much improved. Such harmonisation is demonstrated in the improvements of the European Drought Observatory.

Finally on structural and other measures, the overview of GPs highlighted that there is still some confusion on definitions, the use of terminology and mapping. For example, in forest fire assessments, it is typical to put probability data on one side and fire vulnerability data on the other side. These need to be merged together in order to determine fire risk assessment. The Council Conclusions on Forest Fires already hinted at the need for greater harmonisation. Also, the expert group on forest fires is pushing in this direction.

3.2.5 Industrial hazards

The study team has collected 66 practices from 15 countries in Europe. 13 practices are from international organisations involved in the management and co-ordination of industrial risk.

The collected GPs show, at first review, that a fundamental component to improving the prevention of industrial hazards is to ensure full implementation of the Seveso Directive. The implementation of the Seveso Directive is acknowledged as an effective instrument for reducing the occurrence of accidents in the chemical industry. In addition, there are a number of good practices in MS which further refine the requirements of the Directive or, in some cases, even go beyond those requirements.

Under the Seveso Directive, operators are obliged to produce safety management plans. As regards land-use planning, local authorities and representatives, site owners and the public concerned are involved in the monitoring of risk prevention measures. These requirements under Seveso can inspire good practice in other fields of disaster prevention.

Several identified good practices focus on defining procedures for risk assessment and mapping. Risk assessment typically involves the systematic analysis of possible domino effects and NATECH events. The particularly interesting practices link planning to risk mapping and include the analysis in the decision making process regarding new construction and/or extensions. They also prescribe additional protection on exposed buildings. In Toulouse for example, urban planning legislation forbids construction within a safety zone around industrial installations. The effects of the AZF fertiliser factory accident in Toulouse in 2001 showed how poorly implemented the legislation was in practice. Experts noted that most of the rules related to land-use planning take the form of guidance rather than legislation, and, whilst planners and developers are required to consider the principles of major accident prevention in their land-use planning policies and projects, are not in all cases obliged to comply with a strict set of safety distances, but rather to consider the risks.

3.3 Selection of good practices

The next step was to evaluate the practices from the inventory against the criteria for GP, as identified in section 2.4 of this report. The table below presents an overview of GPs selected from the initial inventory and the corresponding selection criteria that make those practices stand out. Since not all GPs could be analysed in detail, the study team focused on picking out a few from this table that were deemed most relevant for featuring as illustrative examples for each theme in Chapter 4.

Table 5: Overview of highlighted good practices and corresponding selection criteria

Name	Effectiveness	Efficiency	Transferability	Sustainability	Coherence
Horizontal measures					
London climate change adaptation strategy (HM60) UK				7, 12	13, 14, 15, 17
Integration of risk assessment and disaster prevention in planning system (HM34) NORWAY	2			9	13, 14, 15
Regional governance model (Emilia-Romagna) (HM25) ITALY	1		5	7	13, 14, 15, 16, 17
Sweden's National Platform (HM59) SWEDEN	1		4, 5	7, 8, 9, 12	13, 14, 15, 16, 17
Public and schools outreach (HM54) SWEDEN	2		4, 5	8, 9, 12	14, 15
Vigilance system (HM13) FRANCE	1, 2			8, 9, 12	14, 15
Insurance system (HM48) SPAIN	1, 2		5	7, 8, 9, 10, 12	14, 17
Floods and storms					
Flood Resilient Cities (FS 3, 15, 38, 44, 60, 91, 102) MULTI-STATE	1		4	7, 8	14
Cross Border Co-operation - Rhine 2020 (FS1,FS40) GERMANY-NETHERLANDS	1			7, 9, 12	13, 14, 16, 17, 18
Preliminary Flood Risk Assessment (FS100) UNITED KINGDOM	1	3	6	8, 9, 12	16, 17
Flood Awareness Campaign (FS 95) UNITED KINGDOM	1		6	8, 9	12, 13

Name	Effectiveness	Efficiency	Transferability	Sustainability	Coherence
Flood Hazard and Risk Mapping (FS101) UNITED KINGDOM	1			8	16, 17
Early Warning Systems (FS35, FS51) FRANCE - ITALY	1, 2			8, 9	14, 15
Implementation of EU Floods Directive (FS49) ITALY	1		5		13, 16
Floods Directive relevant terminology (FS 105) MULTI-STATE			6	8, 12	14, 16
Earthquakes and tsunamis					
Law No. 5902/2009: Disaster and Emergency Management Presidency (AFAD), a New Disaster Management Structure (EQ1) TURKEY			4, 5	7, 9, 12	13, 14, 18
Microzonation for Earthquake Risk Mitigation: Applied Research Project (EQ8) TURKEY	1		5	7, 12	13, 14, 18
Istanbul Earthquake Rapid Response and Early Warning System (IERREWS), after Decree of Council of Minister on 2001 Fiscal Year (EQ11) TURKEY	1	3	5	7, 8, 10, 12	12, 13, 14, 16
Earthquake Disaster Information System for the Marmara Region (EDIM) (EQ12) TURKEY	1	3		7, 8, 9, 10, 12	13, 16
Eurocode 8 (EC-8) (EQ13) PORTUGAL	1		4, 5	7, 8, 9, 11, 12	18
Probabilistic Seismic Hazard Analysis (PSHA) for Seismic Zonation for Portuguese National Annex of Eurocode 8 (EQ14) PORTUGAL	1		4, 5	7, 8	13, 14, 16, 18

Name	Effectiveness	Efficiency	Transferability	Sustainability	Coherence
Integrated Observations from NEAR Shore Sources of Tsunamis (NEAREST): Towards an Early Warning System (EQ24) PORTUGAL	1, 2	3	4, 5	7, 8, 10, 11, 12	13, 14, 18
CEA: Tsunami alert Centre for the western Mediterranean (EQ38) FRANCE		3	4, 5	7, 8, 9, 12	13, 14, 18
EQ77		3		7, 8, 12	14
Heatwaves droughts and forest fires					
Plans for adaptation to extreme temperatures (HW1, HW7, HW10,) AUSTRIA, FRANCE, GREECE		3	4, 6		18
Early Warning System (HW22) PORTUGAL	2			8, 12	
Implementation of Drought Management Plans (DR1, DR2, DR20) BULGARIA, CYPRUS, UNITED KINGDOM	2		4, 7		14, 16
Albufeira Agreement- art 19 "Droughts and Water Scarcity" (DR14) PORTUGAL AND SPAIN	2			8, 11, 12	14, 18
Guidelines for the identification of areas subject to drought (DR9) ITALY			6	8, 11	14, 18
Monitoring systems (DR10, DR22, DR23) ITALY, SPAIN, ROMANIA		2		8	12
Liguria Regional Forest Plan (FF11) ITALY		3	4, 6		14, 18
Restoration of brook systems (Beekherstel) (DR24) Brabant NL	2	3	6	7	14, 18
Greek National Plan for Combating Desertification		2	4		16, 18

Name	Effectiveness	Efficiency	Transferability	Sustainability	Coherence
(GNCCD) (DR6) GREECE					
Laws for the forest fire prevention Spanish Ministry of the Environment and Rural and Marine Affairs (FF27) SPAIN					18
Fire Risk Mapping (FF13) ITALY			4	8	14, 16
Wildfire Groups (FF52) UK	2	3		7	
Forest Fire Early Warning System (FF10, FF13) GERMANY, ITALY			4	9	
Evora Protocol for Cross Border Co-operation (FF36) SPAIN, PORTUGAL	1			7, 9	13, 14
Industrial hazards					
German 'Kommission für Anlagensicherheit' KAS (IR22) GERMANY	2			7, 9	16
French Commission de suivi de site (IR22) FRANCE	2			7, 9	16
UNECE Convention on the Transboundary Effects of Industrial Accidents (IR55, IR56, IR57, IR58) MULTI-STATE	2	3		9, 10	13, 16
Multi-hazard Mapping– Norway (IR35) NORWAY		3	4, 6	7	14, 16
Mutual Joint Visit (MJV) Programme on Seveso II Inspections JRC-MAHB	2	3	6	7, 8	
Guideline for External emergency plan of industrial establishment with risk of mayor accidents (IR28) ITALY		3	4, 6	8, 10	13
Industrial risk – capacity building for		3		9, 10, 11	14, 16

Name	Effectiveness	Efficiency	Transferability	Sustainability	Coherence
professionals (IR7) DENMARK					
OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response (IR60) and OECD Guidance on Safety Performance Indicators (SPI) (IR 61) MULTI-STATE		3		7, 10	13
Awareness and Preparedness for Emergencies at Local Level (APELL) (IR 62) MULTI-STATE	2		5, 7	10, 11, 12, 13	16

4 Analysis of the good practices

The following chapter provides an in-depth analysis of the common traits found in the good practices (GP) identified for the study. The aim of the exercise has been to find trends and commonalities across the hazard-themes in order to provide horizontal guidelines that can be applied cross-hazard in Europe. The following themes have been identified: governance, planning, information and capacity building, disaster loss data and putting research into practice.

4.1 Governance

Disaster risks have become increasingly intertwined. Floods, storms and forest fires for example are not merely threats to human safety but also to industrial installations and power production that drives economic activity. There is also a growing body of evidence that indicates increasing economic and human costs for disasters.[51] The complexity and magnitude (in terms of human safety and economic costs) of today's disasters requires a more sophisticated governance of disaster risk management (DRM) activities. An integrated approach to issues, level of institution and stakeholder involvement is often needed for adequate planning, implementation and monitoring of DRM activities that take place. The current institutional architecture of DRM in European countries displays a plethora of alternatives in terms of quality and arrangement. While national and regional civil contingency agencies often have been characterised by weak mandates and a lack of resources, examples of good, multi-level governance practices are gradually emerging in Europe and elsewhere at local, regional, national and international levels. Evidence also exists of Member States (MS) working across borders to address common threats. The emerging GPs include integrated, cross-scale and multi-stakeholder arrangements and focus on both single hazards and multi hazards.

The following sections provide a range of examples found in Europe that represent GPs in disaster prevention. Each section ends with a brief analysis of the common characteristics of the governance practices.

4.1.1 Integrated multi-level governance

Disaster prevention takes place at all levels of government, from international to local. The challenge is to co-ordinate stakeholders within each level and across levels.

At the national level, National Platforms for disaster risk reduction (DRR)[52] have been established under the 'Hyogo Framework for Action' (HFA), an international Framework to build resilience and reduce disaster losses[53]. At present, 21 National Platforms are in place among the European Union (EU) Member States (MS) and Civil Protection Mechanism (CPM) participating states[54]. Though varied in composition from country to country, National Platforms are essentially

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51 See for example: Munich Re annual statistics on: http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/annual_statistics.aspx.

52 UNISDR, 2012. European countries meet on international framework for disaster risk reduction. Press release, 1October 2012. http://www.unisdr.org/files/28767_2012no30.pdf.

53 http://www.unisdr.org/.

54 The Community Mechanism for Civil Protection was established in by Council Decision 2001/792/EC establishing a Community Civil Protection Mechanism and recast in 2007 (2007/779/EC, Euratom), to support interventions in case of major emergency events or the threat thereof. Besides the EU 27 Member States, the Mechanism includes: Iceland,

multi-stakeholder forums or committees tasked to enhance dialogue and decision-making and can greatly improve co-ordination processes. A key aspect of many of those in Europe is that they include not just government agencies, but also non-governmental organisations (NGOs) and private sector stakeholders, many of which are essential actors in disaster management and DRR. Good examples of these platforms are found in Sweden (HM59) and Germany (HM17).

The overall purpose of the Swedish National Platform for Disaster Risk Reduction is to prevent and mitigate the consequences of natural disasters by improving co-ordination at local, regional and national levels. The Swedish National Platform, inter alia, provides an arena for co-operation between 17 national authorities and organisations with an aim to increase the collective capabilities of societal stakeholders and support data for their work on natural disasters at local, regional and national levels. For example, in autumn 2010, the National Platform, in co-operation with a number of county administrative boards, conducted a series of seminars on the prevention and management of flood risk. The seminars were conducted at four locations from north to south in the country and information from the authorities was co-ordinated in blocks mixed with good examples from different municipalities. Moreover, the Swedish National Platform also appears to show flexibility in dealing with emerging threats such as climate change.

A different approach to the National Platforms is found in Germany. The German National Platform for DRR was set up in 2000 as the German Committee for Disaster Reduction (DKKV) (HM17). Instead of being a governmental agency, it is registered as an NGO and consists of 35 voluntary committee members and about 20 long-term guest members from policy, administration, science, media, private and aid organisations.

The approach is replicated on a hazard specific level for industrial hazards where the German Commission for Plant Safety (KAS) (IR22) takes a similar multi-level and multi-stakeholder approach. It is also an NGO and consists of representatives from national ministries and agencies, experts, trade unions, industry stakeholders, inspection bodies, representatives of the academic and scientific communities, environmental organisations, etc. It thus ensures a large representation of stakeholders and the involvement of experts from several fields and institutions, guaranteeing good communication and co-operation between stakeholders.

Disaster risk prevention is carried out beyond National Platforms. There is a clear need to involve, co-operate and develop partnerships with voluntary organisations, businesses and academia. There is also a need to ensure good risk governance by authorities on regional and local levels.

First, the role of volunteers is an often indispensable element in reaching out to communities. The sheer number of people involved is impressive. For example, the Italian Red Cross is structured into 21 regional committees, 103 provincial committees, 457 local committees and a fleet consisting of more than 10 000 interventions and relief vehicles. The Italian Red Cross can count on at least 139 000 active members, 23 000 ordinary members and 4 000 employees. They are involved in the complete disaster management cycle, however for prevention they carry out trainings and workshops for the general public and other organisations, for the purposes of raising awareness and preparation.

Lichtenstein, Croatia, Norway, and the Former Yugoslav Republic of Macedonia. The instruments available to the mechanisms include a Monitoring and Information Center (MIC) a Common Emergency and Information System (CECIS), training programmes and civil protection modules that contribute to the rapid response capability.

Second, the role of business is drawing increasing attention. The UK for example, uses various measures that address different topics related to risk management, to prepare the business sector for possible emergencies. The 'Civil Contingencies Act'[55], for example, requires local authorities to provide advice and assistance to businesses. Responders are divided into two categories, where business is part of Category 1 and represents part of the core response to most emergencies. Business is also subject to the full set of civil protection duties, e.g. risk assessment, business continuity management arrangements, or Emergency plans. With risk assessment, the government aims to ensure that all organisations have a clear and effective risk assessment process in place. In Chapter 3 of the 'National Risk Register'[56] entitled "Considerations for businesses and organisations", these measurements are specified. Furthermore, business continuity management[57] (BCM), is defined in the British Standard on Business Continuity Management BS25999 as "*a holistic management process that identifies potential threats to an organisation and the impacts to operations that those threats, if realised, might cause, and which provides a framework for building organisational resilience with the capability for an effective response that safeguards the interests of its key stakeholders, reputation, brand and value creating activities*." It is improving an organisation's flexibility, readiness and ultimate viability to face a disaster. As a result, it increases the possibility for it to continue its activities during an incident and period of disruption.

Third, the use of academia is important to provide scientific understanding on flood risks, seismic activity, and drought patterns, for example. Also, the social sciences play an important part to increase the understanding of a communities' reaction to emergencies and how to improve governance for resilience.

Several examples of effective and local co-operation have also been collected. On a regional level, the Italian civil protection system of Emilia-Romagna (HM25) is a governmental institution that has been put forward as a case for effective integrated, multi-level governance – one that has recently met one of its largest challenges to date, following a series of severe seismic events in May and June 2012. Two major earthquakes and a series of hundreds of aftershocks caused the deaths of 27 people and damaged hundreds of structures, including historical and industrial buildings. Though oriented primarily to disaster preparedness and emergency response, the system's activities also extend into aspects of disaster prevention. The system in Emilia Romagna is based on integration, decentralisation, territorial recovery and joint planning. It brings together all the local authorities (regions, prefectures, provinces, and municipalities) as well as the relevant agencies (the Regional Agency for Civil Protection, fire brigades, State Forestry Corp, municipal police, regional technical bodies, voluntary associations, the Italian Red Cross, the scientific community, etc.). The system explicitly calls for specific institutional agreements with all these actors, in order to facilitate the co-ordination and management of disaster interventions, in conjunction with a recently-strengthened network of more than 200 permanent civil protection centres. In Emilia-Romagna, the civil protection system is designed to reduce risks of multiple hazards. Furthermore, it is based on innovative choices, such as that of "territorial recovery". According to this principle, after the emergency response, the recovery phase has to improve the territorial condition and not simply bring it to its status ex-ante.

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55 http://www.cabinetoffice.gov.uk/content/civil-contingencies-act.

56 UK Cabinet office. For further information, please visit: http://www.cabinetoffice.gov.uk/sites/default/files/resources/Chapter_3-Considerations_for_business_and_organisations-2010_Edition.pdf.

57 UK Cabinet office. For further information, please visit: http://www.cabinetoffice.gov.uk/content/business-continuity.

Even locally, the disaster response can be multi-level and inclusive. The Red Cross for example, in their programme on minimum standards for local climate-smart DRR, emphasise the need to bridge national policy with community resilience. The Red Cross has carried out a number of case studies to show how resilience to hazards and climate change could be highly effective if carried out on a community level. The programme shows how local needs and knowledge must be accommodated to develop strategies and actions for resilience.[58]

An integrated perspective is found in the EU funded FloodResilientCity (FRC) initiative (FL3, FL15, FL38, FL44, FL60 and FL91). It engages local authorities in eight cities that are supported in improving and sharing practices in adapting to emerging threats from larger urban populations, increased building stocks and increased urban risks from hazards such as floods and storms. The co-operation could be characterised as local and cross-border co-operation where "lessons learned" in one city could yield positive effects in another. It shows how DRR benefits from taking place at 'low' levels of authority, such as exchanging experience and knowledge amongst European regions and cities in similar situations. On an even smaller scale but similar in implementation, in Liesingbach, Austria (FL13), a joint project brought together the Vienna City Council Department number 45 (Water Engineering), number 30 (Vienna Channel) and Waste Disposal Operations Simmering, to improve the economic and ecological function of the local river. It gathered an interdisciplinary planning team comprising ecologists, landscape planners and water engineers. It showed how on a rather local level, co-operation across authorities and industries ameliorates the situation.

While most GPs on multi-level governance address several hazards, they could zoom in one hazard. A good example of a single hazard governance mechanism is the Rhine Floods Emergency Association (HWNG) (FL43). The association consists of several municipalities, cities and community groups in the Middle and Lower Rhine to represent their interests for improved flood protection. The association can be characterised as a "community of solidarity", whose members commit themselves to mutual assistance. Due to the cross-border scale of the flood risks in the Rhine river basin, the HWNG Rhine also closely co-operates with Dutch municipalities who were involved in the drafting of the Action Plan promoted by the International Commission for the Protection of the Rhine (ICPR) as an NGO. An important aspect is that the institutional arrangement is made on the basis of the ecosystem – in this case the Rhine – rather than national borders.

Another good example of a single-hazard, yet horizontal approach is embodied in the Norwegian Directorate for Civil Protection and Emergency Planning (DSB) (IR39) which is mandated to co-ordinate the transportation of dangerous substances within Norway. The DSB is the co-ordinating agency of the committee, which focuses on analysing challenges, regulations, emergency preparedness and joint inspections. It has established close co-operation with authorities (including authorities regarding air and sea transport) and stakeholders through regular meetings. Over the last 3 years, Norway has been in dialog (through meetings and seminars) with all 17 authorities involved, in order to establish a nationwide picture of the national risk scenarios and all challenges regarding dangerous substances. In this matter, dialog with neighbouring countries has also been important.

[58] Red Cross, 2012. Minimum Standards for local climate-smart Disaster Risk Reduction – enabling integration of local capacities into national climate adaptation strategies. Available at: http://www.climatecentre.org/downloads/File/Minimum%20Standards/Policy-brief-and-MinStd-CDKN-PfR-Final-2OCT12.pdf.

To conclude, GPs within integrated multi-level governance are different in institutional set-up, administrative level and hazard focus. They share however three key features:

(1) They are multi-stakeholders, which means that GPs include a broad range of stakeholders from government, industry, academia, voluntary organisations, local communities and other interest groups at an early stage in the planning process. The stakeholders involved do not necessarily have primary responsibility for prevention, but may also include sectoral agencies such as those responsible for housing, infrastructure, utilities, health care, economic and land use planning, etc., as well as those primarily engaged in emergency response and recovery. As a result, decisions are based on a diverse expertise and on different views leading to more transparency and a broader agreement across sectors and socio-economic groups.

(2) They are multi-level, which means that GPs work across administrative and geographical levels. Depending on hazard or hazards that need to be tackled, the response is designed accordingly.

(3) They are integrated, which means that multiple hazards and their cross sectoral their linkages are considered in the planning and implementation process. It goes hand in hand with the first two points, multi-level and multi-stakeholder, which is necessary to create an appropriate response to the hazard(s).

4.1.2 Cross-border co-ordination and co-operation

When disaster risks cross national borders, disaster risk prevention becomes an international matter. The response must be adequate to reduce the negative effects of cross-border hazards by identifying common risks, setting up joint management systems and sharing knowledge and experiences. Europe has a long tradition in disaster risk prevention across borders and bilateral agreements between countries that have been complemented with European legislation.

Among the more effective cross-border disaster risk reduction arrangements are found in European flood prevention. In accordance with the Water Framework Directive (WFD), several MS and non-EU MS have set up governing bodies at a river basin level. Some of these, such as the International Commission for the Protection of the Danube River (ICPDR) and the ICPR, have a long history of cross-border co-operation before the European Directives came into force. The cross-border co-operation in the Rhine (FL1 & FL40), for example, has been in place for more than 60 years and has created a forum for stakeholders to discuss common policies, decision-making processes and emerging threats. The ICPR has developed a plan for flood prevention that aims to: reduce damages and risks by 2020; increase flood awareness; improve flood warning systems; and increase water retention by reactivating inundated areas, maintaining and strengthening dikes and drafting maps illustrating the risks of inundation (for spatial planners). A particularly good feature with the Rhine regime is the ability to take an integrated approach to water management including droughts and water-quality. Initiatives similar to the Cross-border co-operation in the Rhine are found in other catchments in Europe such as the Danube, Oder, Elbe and Mosel rivers.

On a bilateral level, the Spanish-Portuguese Albufeira agreement (DR14) is an example of good practice in cross-border co-operation. The agreement was set up in 1998 to improve co-ordination between the two countries and aims at: prevention of floods, control of water scarcity and drought situations, establishment of exceptional mechanisms for mitigation of effects and exception to the normal regimen. The agreement has improved co-operation across national, regional and local scales and has been particularly effective for knowledge sharing. Documentation is kept well organised in language that is often understandable for non-experts. A single portal for information concerning the agreement has been established (www.cadc-albufeira.org) and discussed regularly

to cope with emerging challenges. Comparable to the Albuferia agreement is the Evora Protocol (FF36), approved in 2003, which covers Spanish suppression actions in Portuguese territory and vice versa within 15km of both sides of the countries' borders. The Protocol establishes the mechanisms to activate the suppression resources and the chain of command and information sharing.

Cross-border co-operation can also be useful in more concrete cases for issues such as data and material sharing. The Nordic countries for example, have a network for geographic data concerning disaster management (HM 57). Started in 2006, it contributes to an exchange of information about the area of public security and emergency service within the network and the crisis management in the neighbour countries. The agreement covers data exchange between the participating countries' land survey authorities and makes it possible to serve the neighbouring country with geographic data within a corridor of 100 km in the other countries territory for efficient co-operation in crisis situations. An INTERREG project promoted by the EU is under development between country administrative boards in Norway and Sweden. The network meets twice a year and one workshop per year is arranged with the organisation GI Norden. The participants are authorities for crisis management and civil protection, land surveys and police.

In summary, for some hazard types, institutions for cross-border co-operation have a long tradition in Europe. European legislation, in particular on floods, has provided further impetus for co-operation. Another example is the area of industrial accident prevention, where there is a UN Convention signed by the EU and its Member States on the Transboundary Effects of Industrial Accidents[59]. The Convention is implemented in the EU through the Seveso Directive, which includes obligations to inform neighbouring Member States of (potential) accidents. Good co-operation across borders can therefore in some cases be enhanced by following examples in hazard specific areas such as floods. Cross-border co-operation adds an international dimension and emphasises the importance of multi-level governance and the involvement of multiple stakeholders. Cross-border co-operation does not necessarily require the setting up of large bodies or commissions, but can also focus on more practical matters such as sharing information and resources to combat disasters and the consideration of transboundary risks from neighbouring countries in planning and implementation.

4.1.3 Integration across EU sectoral and hazard-specific legislation

Disaster prevention is embedded in a large number of legislative sectors such as industry, water, agriculture, environment, energy and climate. To create an effective legislative framework on a European, national and local level, it is important that sectoral policies are integrated into broader DRM and hazard specific considerations. A coherent approach also improves the conditions for co-operation, resource and information sharing. Common standards and terminology could therefore be a step in the right direction towards coherence across European sectoral and hazard-specific legislation.

Harmonisation of DRM related policies across EU MS

A good practice in the direction of common standards is the Eurocode 8 on the seismic design of buildings (EQ13). Eurocode 8 is part of the currently 10 Eurocodes that provide a common European approach on how to design buildings and other constructions and construction products in accordance with European law. They are determined by the European Committee for Standardisation and are expected to replace national standards. Eurocode 8 introduces a European

[59] http://www.unece.org/env/teia.html.

structural design code to improve buildings' and other constructions' resilience to earthquakes. The Eurocode 8 applies only to constructions in "seismic regions" and covers, for example, general rules, bridges, silos, pipelines, foundations, retrofitting of buildings and towers.[60] While the practice is aimed towards earthquakes, the general implementation is expected to increase the competitiveness of European civil engineering firms, contractors, designers and product manufacturers in their worldwide activities; and toward quality improvement of the design for building and civil engineering works. Eurocode 8 is a self-standing document for seismic regulation and the integration of seismic regulation into action and material codes. The implementation, harmonisation and developments of the Eurocodes, including Eurocode 8, are discussed on a continuous basis, which enables it to adapt its standards for new findings from research and practice and changing risks.

One such adaptive feature is the capability of building and planning guidelines to accommodate future risk. Climate change is likely to enhance several hazards and put increasing pressure on buildings and infrastructure. Building codes and planners in several countries and cities are increasingly incorporating climate change into decision-making. In the Swedish Planning and Building Act for example, municipalities are obliged to factor in risks such as flooding and erosion into their decisions. Since 2011, the Act has been updated to incorporate climate adaptation in city planning.

Another good practice of good legislative coherence for disaster prevention is the Floods Directive.[61] Adopted in 2007 it requires MS to assess and manage flood risks. Implementation is ongoing in several countries and projects (FL31, FL39, FL55, FL72, FL81) and outlines the administrative and operational issues, including the costs, benefits, risks and impacts associated with the transposition process. It introduces new tools and practices based on hazard and risk cartography and deals with the preliminary assessment of flood risks, hazard and risk maps, co-ordination between actors and all public authorities. Similarly, on an international level, is the United Nation's Economic Commission for Europe's (UNECE) 'Convention on the Transboundary Effects of Industrial Accidents' (IR55). The Convention promotes active international co-operation between countries before, during and after an industrial accident. It tackles prevention, preparation and response to industrial accidents (particularly those with possible transboundary effects). The Convention also encourages its parties to help each other in the event of an accident, to co-operate on research and development, and to share information and technology. It entered into force on 19 April 2000 and now counts 40 Parties including the EU. The Convention has good co-operation with the Committee of Competent Authorities of the EU Seveso Directive.

Coherence across European legislative fields is generally a matter of implementation of EU legislation. Eurocode 8 and the Floods Directive require MS to adopt similar standards, assessments and instruments to disaster prevention, but it is for each country to transpose the legislation into law and implement its provision. Clearly, there is a necessity to ensure internal coherence across EU legislative areas. The implementation, monitoring and evaluation of the Floods Directive for example, are aligned with the provisions of the WFD.

Mainstreaming DRM and climate adaptation

Climate adaptation is an emerging policy field with relevance to disaster prevention. Given the potential for climate change to alter the intensity and/or frequency of weather extremes, a strong argument can readily be made for the integration of climate change adaptation into DRR policy and

[60] JRC, 2011. Eurocode 8: Seismic Design of Buildings. Worked examples. Written by: P. Bisch, E. Carvalho, H. Degee, P. Fajfar, M. Fardis, P. Franchin, M. Kreslin, A. Pecker, P. Pinto, A. Plumier, H. Somja, G. Tsionis.

[61] EC, 2007. Directive 2007/60/EC on the assessment and management of flood risks.

practice. In a less direct sense, the implications of climate change may not only increase exposure to climatic hazards but also increase social vulnerability to a range of emergency events through undermining economic livelihoods and the status of environmental resources, together with other complex impacts on society. Moreover, evidence is increasingly emerging that climate change is already producing impacts in certain places and for certain sectors. Climate change is therefore a major factor for DRM and an added pressure on DRM governance functions.

The need to integrate DRM and climate adaptation – also called "mainstreaming" – into planning and sectoral policies such as economic, social and sustainable development policies is something that has received increasing attention. The latest Intergovernmental Panel on Climate Change (IPCC) report on DRM and climate change emphasised the need to develop "stand-alone adaptation policies" as well as to mainstream adaptation and DRM policies into existing policies. The IPCC (p. 355) concludes that: "*Mainstreaming of adaptation and disaster risk management actions implies that national, sub-national, and local authorities adopt, expand, and enhance measures that factor disaster and climate risks into their normal plans, policies, strategies, programs, sectors, and organizations"*.[62]

As noted by the IPCC[63], it is sometimes challenging to really understand what mainstreaming means in practice. One GP on climate change adaptation however, is the 'London Climate Change Strategy' (HM60) launched by the mayor of London. The Strategy has been developed through consultation with a range of stakeholders and with the aim of improving the management of climate risks through focusing on a number of strategic areas of policy and action. It places important emphasis on assessment of risks, information flows and collaborative working across stakeholders and sets in place a framework of priorities and responsibilities to guide future interventions. Its analysis of risk recognises that vulnerability is not solely related to exposure and that a key task for prioritisation is to identify who/what is most vulnerable and what sectoral impacts are most critical. The Strategy could be seen in the context of a national Climate Change Act from 2008 that aims to prepare the UK for the impacts of climate change (HM66). It sets a national adaptation programme in place which is supposed to be reviewed every fifth year and empowers the UK government to require that relevant bodies, for example those dealing with water and energy utilities, provide reports on their preparations for adaptation. It set up an Adaptation Sub-Committee to the independent Committee on Climate Change to advice on climate adaptation.

To co-ordinate DRR activities and climate adaptation in Norway, the National Platform and the Norwegian Climate Adaptation Programme share secretariat (HM37). The aim is to develop the platform in close connection with the climate adaptation programme to ensure coherency, efficiency and effectiveness of the two programmes.

On a sectoral level, the Swedish Planning and Building Act (HM52) provide a GP on climate adaptation. It requires municipalities to take into consideration disaster risks such as flooding and erosion and determines whether an area is suitable for development in terms of health and safety for its citizens. In May 2011, the legal framework was improved and now provides further protection against natural disasters including requirements to take climate change adaptation into consideration during city planning.

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62 IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

63 Ibid.

Climate adaptation does not necessarily imply new organisations, laws, standards, or processes. It heightens however, the urgency to improve current DRM activities. To mainstream climate change means that uncertainties and shocks to the system must be taken into account when planning and implementing DRM activities. Until recently, there has been a tendency for climate change adaptation and DRM to be led by different agencies working in weak co-operation (often climate change falls under the responsibilities of a department of environment), but the logic of working together and developing joint risk management strategies has come to fruition in a growing number of examples. These include disaster prevention mechanisms that explicitly include attention to climate impacts, as in Norway's land use planning processes (HM37), London's climate strategy (HM60) and Sweden's educational work on risk (HM54) climate adaptation.

4.2 Planning

Planning is a central theme in DRM. Every community, at various levels of government, faces environmental risks and the potential for disaster increases as population density in hazardous areas grows, the built environment ages, and economies are interdependent. Planning for addressing such risks has thus gained in importance. Vulnerability reflects both the physical environment (e.g. land use choices, building codes, etc.) and the socio-economic vulnerability of populations and institutions (e.g. knowledge, resources, and networks). Additionally, if risks are not assessed and considered in the planning process, many decisions and policies could have profound but unrecognised impacts on disaster risks. A sound understanding of risk and risk management is thus of utmost importance for all planners to help build disaster-resilient communities. To this end, each locality should have the tools to understand the risks it faces, so that consequently in the planning process, responsible and holistic policy decisions can be taken and DRM can be aligned with broader environmental, social and economic goals.

Planning thus can be defined as the process undertaken by authorities and other stakeholders to identify, understand, assess, and plan for addressing disaster risks via holistic decisions on policy options. Private actors carry out planning processes such as business continuity planning, at different levels of government. Good planning can raise awareness, understanding and a sense of ownership by enabling inclusive approaches where communities are spurred to participate. Moreover, planning offers opportunities for authorities, from international to local, to streamline actions.

The various dimensions of the planning process make clear the need for comprehensive and systematic risk assessment as a basic starting point. Risk assessment can be carried out for either single hazards or specific sectors, as well as on a broader multi-hazard national scale. Various tools and methodologies exist to aid decision-makers in the review of risks and associated policy planning processes, such as micro-zoning or early warning systems (EWS). Further, financing mechanisms need to be aligned with the results of risk assessments in order to help foster the chosen policy direction. For example, using financial risk transfer methods and financial incentives such as insurance, currently appears to be under-exploited.

The following sections provide a range of examples found in Europe that represent GPs in planning processes for DRM. More specifically, the use of risk assessment as a starting point in planning for policy is analysed. In addition, some sectoral and hazard-specific methods and technologies, including land use planning measures (e.g. hazard risk mapping and micro-zoning), structural measures to protect buildings and infrastructure (e.g. seismic design codes and flood protection guidelines for buildings), and the role of EWS and how these can help inform planning processes and increase resilience, are explored. Finally, financing mechanisms related to the planning

process are highlighted. Each of these sections ends with a brief analysis of the common characteristics of the planning practices.

4.2.1 *Risk assessment as a starting point in planning for policy*

Risk assessment across all levels of government and across all hazard types is increasingly viewed as a prerequisite, a basic starting point for a thorough planning process and efficient DRM. The integration of risk assessment into decision-making represents an important first step, not only for setting up concrete DRM plans, but also for short term and long term policy making (environmental impact assessment, land use planning, infrastructure development, etc.), for orienting financial mechanisms, recovery measures, as well as capacity and response planning.

A review of the collected GPs shows that this does not necessarily mean that one multi-hazard national risk assessment is sufficient. Rather, risks need to be analysed at all levels of government, from a single and/or multi-hazard perspective (depending on circumstances) and should be streamlined across sectors.

Risk assessment across levels of government

On an international level, the HFA, in its priorities for the period 2005-2015[64], has emphasised the importance of an integrated, multi-hazard DRM approach that should be factored into policy-making, planning and programming. Thus, one of the strategic goals that countries have committed to under the HFA is an effective integration of disaster risk assessments into planning and programming for various sectors and at all levels. To convert this goal into practical action, national governments need to work on developing guidelines for risk assessment and mainstreaming DRM into planning for policy.

In an attempt to provide guidance to MS on how to carry out national risk assessments, the European Commission issued EU Guidelines[65] for National Risk Assessment in 2010. These Guidelines aim to develop a common approach on risk assessment methodologies and practices undertaken by the EU MS at a national level, as well as orientation on matters of terminology, the involvement of different sectors and stakeholders, and the most useful methods and concepts. The Guidelines take full account of existing EU legislation including the Directives on flood risk management, protection of European critical infrastructures, and on the control of major accident hazards (Seveso), the WFD (drought management). Moreover, the Guidelines consider a number of Eurocodes, such as Eurocode 8 on building design standards for seismic risks, and also the Council Conclusions on Prevention of Forest Fires within the EU.

National risk assessments usually include risks, which are of sufficient severity to entail involvement by national governments in the response, in particular via civil protection services. At the national level, there have been major advances in national level risk assessment processes in countries such as the Netherlands, UK and Norway. The UK, for example, uses the classified National Risk Assessment (HM63) led by the Cabinet Office as its primary process to classify risks. This is a comprehensive, classified assessment of the most significant emergencies that the UK could face over the next five years. There are three stages to the assessment: the identification of hazards; assessment of the risks and their impacts; and comparison of the risks. To make this knowledge available publicly, an unclassified version of the National Risk Assessment, the National Risk

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64 UNISDR. Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. Extract from the final report of the World Conference on Disaster Reduction (A/CONE206/6).

65 EC, 2010. COMMISSION STAFF WORKING PAPER Risk Assessment and Mapping Guidelines for Disaster Management SEC (2010) 1626 final.

Register, is produced in parallel, to assist interested communities and individuals in improving their own risk assessment and DRM activities.

Norway's Planning and Building Act (HM34) is an instrument for integrating disaster prevention into planning processes at a local level. It requires municipalities to carry out risk and vulnerability assessments as part of the planning process. The act enables the definition of zones that require special attention based on these risk and vulnerability assessments. Building restrictions can be applied to such areas for which local authorities find it necessary to carry out more thorough risk assessments, or where special building codes may apply in order to maintain safety. Flood risk, landslide risk, threatened biodiversity and cultural heritage can all be used to define these zones. The Norwegian Directorate for Civil Protection and Emergency Planning (DSB) has developed a guide on how to integrate disaster prevention into municipal land-use planning. The Technical Regulations under the Planning and Building Act concern the physical design and location of buildings and infrastructure, providing Directives for how various types of buildings should be adjusted for different risks, for example different flood levels. This demonstrates the advantages of applying vertical governance structures for DRM as the national level risk assessment can support local level risk assessment and planning processes.

Another national level risk assessment programme is the so-called National Hazardscape Report (HM69) in New Zealand. This GP from outside Europe demonstrates what a comprehensive national risk report could look like. The Report is a non-statutory document aimed at informing policy makers and DRM managers in carrying out hazard and risk management at the national and local level. Published in September 2007, it is the first report to provide a thorough description of the New Zealand hazardscape, including a summary of the physical nature, distribution, frequency of occurrence and their impacts, and consequences of 17 key hazards. The report also provides information on how the hazards are currently managed across the disaster management cycle.

A GP displaying the advantages of using risk assessment as a starting point for integrated governance and planning on a regional level is the Emilia Romagna region in Italy (HM25). Its regional civil protection system is based on integrated and shared multi-hazard risk assessment, planning and governance involving a wide variety of actors (local authorities, relevant agencies, volunteers, etc.). While the system is designed to manage a range of hazards affecting the region, differentiated DRM plans have been developed for the specific hazard types, in order to refine the required actions for each step of the disaster management cycle based on the results of risk assessments. For earthquakes, for example, continuous risk assessments since the recent 2012 earthquakes in the region have demonstrated a high risk of major earthquakes in the near future; as a result, the system is currently trying to introduce into the planning process, as a key measure, the stricter application of seismic building design codes, including the upgrading of existing buildings.

Integration between multi-hazard risk assessment and DRM is especially relevant at the local level, where detailed land use planning takes place. For many hazard types, land use planning can play a central role in enhancing community resilience through, for example, planned citing of critical infrastructure. In order to do so effectively, planning and zoning decisions must be based on detailed information via local-scale risk assessments. The example of Norway (HM34), where municipal-level risk assessments are undertaken as a crucial input to municipal planning and development control, represents a GP of how to integrate local risk assessment into municipal planning. Norway's Planning and Building Act (passed in 2008) requires municipalities to undertake risk and vulnerability assessments as part of the planning process. Municipal councils must develop a municipal planning strategy, master plan and zoning plan. The land-use planning process thus takes a genuinely preventive approach to DRM. It aims to reduce exposure to risk through

restrictions on the location of new development and to mitigate damage through the application of special building regulations, taking into account Eurocode 8.

Planning by the private sector

Business continuity planning represents the creation and validation of a practical and logistical plan for how an organisation will prevent, prepare for, recover from and restore, partially or completely, interrupted critical functions within a determined timeframe after a disaster. Business continuity planning also involves risk assessment as a starting point. Businesses, just like governments, need to know all the likely risks they may have to face before commencing the planning process. All organisations face business continuity risks and appropriate planning makes all the difference: while 80% of organisations with a validated business continuity plan are likely to survive a major disaster, only 20% of those without a plan are likely to survive[66].

Developing organisation-wide situational awareness and establishing an ongoing business continuity programme can help private sector firms cope with, and be more resilient to, hazard events. Inadequate planning prior to a disaster event can have serious effects on operations, profitability and quality of service, not only due to the disruption itself, but also due to lost time. Business continuity planning, similar to public sector planning, typically covers the following areas: risk assessment, disaster recovery and business resumption planning, determination of recovery alternatives, validation of continuity plans, implementation of the plan, awareness raising and related trainings.

In May 2012 the International Standards Organisation (ISO) launched a business continuity standard, ISO22301, setting out the requirements for a Business Continuity Management System. These requirements can be applied to any organisation, irrespective of its size, type or location. Compliance with this standard is a sign that an organisation is prepared for managing disruptive events. ISO22301 is based on the Plan-Do-Check-Act model.

A GP for business continuity planning comes from the UK, where the UK Companies Act 2006[67] embeds business continuity planning firmly into the legal framework. The Act gives statutory force to the role of directors as exercising due care in relation to their companies; specifically, directors must “exercise reasonable care, skill and diligence”, triggering the development and implementation of business continuity plans. Additionally, the Civil Contingencies Act 2004[68] sets out specific duties for public bodies (known as ‘category 1 responders’) in England, Wales, Scotland and Northern Ireland. These duties include the duty to assess the risk of an emergency occurring and to maintain plans for mitigating and responding to an emergency. The Act also imposes duties on other local bodies (known as ‘category 2 responders’) to co-operate with and inform category 1 responders in relation to risk assessment and the development of continuity plans.

Hazard and sector specific risk assessment

Alongside the need to be applied at all levels of government, it is important that risk assessments work across all relevant hazards. Much can be learned for the multi-hazard context from advances in assessment and preventive planning for specific hazards and/or sectors, particularly in the case of flooding, where strong examples already exist in several countries. Preliminary and full-scale flood risk assessments, for example those practiced in the UK (FL100), Finland (FL26), France (FL31), Ireland (FL57) and Norway (FL62), demonstrate various lessons on the usefulness of local

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66 Business Continuity Institute. Survey 2005.

67 http://www.legislation.gov.uk/ukpga.

68 http://www.legislation.gov.uk/ukpga.

risk assessments. Lessons learned from these experiences in the flooding context can potentially be transferred to a multi-hazard level.

The Preliminary Flood Risk Assessments (PFRA) (FL100) report from Oxfordshire County in the UK represents a GP example of a broad-scale and strategic assessment of flood risk that successfully considered the requests of the EU Floods Directive at the local level. Guidance documents on preliminary flood risk assessment have been developed at the national (UK) level and this GP shows the application of these recommendations on a local scale, thus also demonstrating the advantages of vertical governance for DRM.

Similarly, the French management plans for flood risk (PGRI) under the Grenelle 2 law (FL31) demonstrate GP for co-operation between different actors and levels of government in the implementation of the EU Floods Directive. These management plans must also be based on detailed risk assessment and are set up at the level of local river basins.

The Irish (FL57) use of their flood risk assessment and planning system shows how risk assessment can be utilised as a guideline for Planning Authorities at national, regional and local levels for the citing of new development areas.

Additionally, the earthquake risk assessment tool for Istanbul's metropolitan area (EQ6)[69] demonstrates how the integration of risk assessment tools can aid local level decision-making and planning processes for DRM. The development of this localised risk model uses the University of Bogazici Department of Earthquake Engineering's own software "KOERILoss". In addition to determining exposure and hazard levels, this software applies a loss estimation methodology, including probabilistic estimations, to perform loss estimates. This risk assessment tool focuses on assessing social vulnerabilities and infrastructures, such as schools, clinics and public spaces, in order to align policy planning accordingly. This GP illustrates not only the use of specific risk assessment methodologies and how it can inform local planning processes, but also the advantages of collaboration between various stakeholders, in this case local government and universities.

What can be learned from these specific examples, is that the process of risk assessment at the local level gains benefit from guidance documents at the national or EU level, not only for help in meeting the requirements of existing legislation (e.g. implementation of the EU Floods Directive), but also in offering technical detail on common methodologies to be applied for risk assessment. In principle, lessons learned from these practices could be adapted and applied for risk assessments of other hazard types.

The French example (FL33) of embedding flood prevention measures for planning purposes, via its 1995 law establishing plans for the prevention of natural risks, Plan de Prévention des Risques (PPR), demonstrates how risk assessment and the associated structural and non-structural risk prevention measures, can be well co-ordinated and used for wider planning purposes, such as land use planning. The policy prioritises human safety and requires collective or specific action, especially in the fields of urban planning, construction and the management of land, both in exposed areas and in areas that are not exposed but may contribute to worsening or creating new risk. The main areas of structural intervention are: runoff management; reducing barriers to water flow; development of floodplains; organisation of stormwater drainage; strengthening the structure of buildings; and the protection of urban areas against floods.

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[69] www.koeri.boun.edu.tr.

Similarly, flood risk prevention for planning purposes is used in Spain (FL82). The so-called 'Sistema Nacional de Cartografía de Zonas Inundables (SNCZI), is an instrument for the management of flood risk prevention, for planning procedures and for administrative transparency. SNCZI provides cartographic information on flooded areas and a web application enables all interested people to view national flood hazard maps and associated aerial photographs provided by the Dominio Público Hidráulico (DPH). Also, Norway (IR36) represents a good example of carrying out land use planning according to industrial risk assessment. The Norwegian Planning and Building Act and the Norwegian Environmental Impact Assessment Regulation both govern land use planning. Within the Act, requirements are set for contingency planning in municipalities and counties, including risk and vulnerability assessments for all new development areas.

Taking a common approach and linking various sector-specific and/or hazard specific risk assessment methodologies is thus desirable. For example, methodologies could align to consider and include natural and man-made risks, such as flood risk assessment, climate risk assessment, critical infrastructure risk assessment, and offshore safety risk assessment. Taking this common approach and linking various existing risk assessment procedures requires the close co-operation of all stakeholders involved. The critical infrastructure risk assessment, for example, is mandated by the EU Directive on Critical Infrastructure, but performed by the business operators.

To conclude, GPs demonstrating the use of risk assessment as a starting point for planning, have highlighted the following key features:

- Risk assessment helps to guide policy making when integrated into planning processes, such as land use planning at the local level, or sustainable development policies at the national level:
  - Using multi-hazard, integrated risk assessment as a basis for policy planning is in line with the HFA priorities for action. More effective integration of disaster risk considerations into planning and programming at all levels has been defined as one of the strategic goals that countries have committed to.
- The EU Guidelines on National Risk Assessment offer a good basis for developing a common approach and ensuring coherence of risk assessment approaches across Europe:
  - To ensure successful integration of risk assessment in planning processes, co-operation between all levels of government should be maintained;
  - Whether focusing on a single hazard or multiple hazards, risk assessment is applicable at all levels of government as a tool to guide planning.
- When drafting methodologies or guidelines for multi-hazard risk assessment, lessons can be learned from sector-specific and/or hazard-specific initiatives. Linking various assessment processes together is desirable.

4.2.2 Risk management planning for prevention

Risk management planning is an important component of disaster prevention. It is an instrument to foresee risk, to estimate their impacts, and to develop, select and implement measures to reduce, adapt to and mitigate these risks and their impacts cost-effectively. The primary goals of establishing risk management plans are to help raise the level of prevention by ensuring that a country takes informed actions to address the risks it is facing; better link the various phases of the DRM cycle by improving the integration of prevention; and increase awareness and strategic investments in disaster prevention.

Prevention and preparedness measures to reduce risks can include technical, regulatory, financial or communication measures. A plan should always be supported by an implementation action programme, detailing the priorities and corresponding responsibilities, targets and timeframes. In

Europe, cooperation in this area can generate benefits in particular for cross-border risks, such as flooding in river basins or forest fires, and multi-hazard events, such as a severe storm with flash floods.

Planning for risk management is typically done within sectors, however, there is added value in bringing together the different sectoral efforts into a general overview and making them somewhat comparable across sectors. Another goal of risk management planning is thus to set a framework for integrating different sector and hazard-specific risk management instruments into a common overall plan. Thus, the implementation of the framework would allow for jointly organising and monitoring progress, even if some instruments remain hazard/sector specific and cannot be scaled up to a multi-hazard approach.

A GP highlighting the benefits of risk management planning for prevention is the French PPR[70] (HM11). These plans are prepared by local government to categorise land on the basis of risk of a natural or industrial disaster. In some urban areas there are also separate plans for industrial risks, called Plans de Prévention des Risques Technologiques (PPRT). The risk plan for prevention divides the geographic area into three planning zones: red zone – no planning permission granted; blue zone – planning permission subject to conditions; white zone – planning permission subject to local planning regulations. Once in place, these plans enable greater surveillance of risk areas by officials, and local authorities are required to put in place measures to reduce the level of risk, notably via appropriate infrastructure works. Thus, in those areas evaluated to face a high risk of fire for example, a local authority will need to consider the construction of new access roads for fire and rescue vehicles.

4.2.3 *Specific sectoral and single-hazard assessment methods and technologies*

In addition to the methodological GP approaches, sector and/or hazard specific assessment tools and methods are applied for aiding in risk assessment and subsequent planning purposes. More specifically, seismic hazard mapping and micro-zoning for earthquake prevention, fire risk mapping, as well as flood risk mapping, are examples for using risk assessment and mapping exercises as a guidance tool for land use planning. Even more concrete structural DRM measures, such as seismic design codes and building codes for flood prevention, bring further direction not only to land use planning but also to building design. Components of EWS make up an important part of prevention and they can play a key role in helping to inform planning processes and increase resilience.

Hazard mapping

Seismic hazard mapping (on a macro-scale) and micro-zoning are two effective practices used in planning for earthquake risk. Since the actual earthquake is impossible to prevent or predict accurately, zoning for spatial planning is a crucial tool for minimising risk and vulnerabilities of humans and critical infrastructure.

To exemplify how seismic hazard mapping can help inform local planning processes, a GP from Portugal has been chosen. The practice (EQ14) entails the Probabilistic Seismic Hazard Analysis (PSHA) for seismic zonation, enhancing the implementation of Eurocode 8 and obtaining seismic zonation for Portugal's mainland, the Azores and the Madeira archipelagos. The practice supports the standardisation of the quality of buildings and critical infrastructure, as well as the harmonisation of national seismic action. For the seismic hazard mapping to function effectively, good

[70] http://www.risquesnaturels.re/risques/plan-de-prevention-des-risques-ppr.

communication and co-operation between regions/cities and the national government needed to be in place. Such integrated governance for the transposition of Eurocode 8 also helped strengthen institutional capacity and multi-stakeholder dialogue.

Micro-zoning

While seismic hazard mapping (macro-scale) takes into account the distribution of seismic hazard over an entire country or region, seismic micro-zoning takes into account the effect of the local site conditions i.e. the detailed distribution of earthquake risk within each seismic zone. For seismic micro-zoning, all data related to geology, ground acceleration, historical earthquake and remote sensing derived parameters are incorporated into a common spatial database and then analysed to get a small-scale hazard map. For instance, the micro-zoning maps of a metropolitan area are able to include such fine details on a local scale. Micro-zoning was deemed too time-consuming and knowledge-intensive for being considered as a cross-cutting minimum standard. Most authorities in charge of DRM do not have at their disposal adequate resources, both in terms of money and manpower, to carry out large-scale micro-zoning efforts. However, it is an important measure that can certainly help to guide the planning processes for earthquake risk reduction and should therefore be encouraged.

In spite of the fact that micro-zoning has been developing since the 1960s as an earthquake prevention practice, starting mainly in New Zealand and Italy, unlike seismic hazard mapping through Eurocode 8, there is currently no international standardisation of the approach. If micro-zoning is to be turned into a truly useful prevention measure from a practical planning point of view, then parameters, methodologies and technologies should be standardised internationally. There are nevertheless some existing efforts in this direction. A GP from Turkey (EQ8) is an applied research project that is working towards a definition of seismic micro-zonation methodology. This is done through a user manual they have developed on 'Seismic Micro-zonation for Municipalities' and micro-zonation studies conducted in two pilot areas (1) Adapazarı, (2) Gölcük, İhsaniye and Değirmedere, for testing and demonstrating the applicability of the proposed micro-zonation procedures and accompanying user manual.

Fire-risk mapping

Yet another sector-specific GP that demonstrates the advantages of using risk assessment tools as a basis for planning is fire risk mapping (FF13). Due to limited funding for fire prevention activities, fire risk maps are established in Italy on an annual basis to determine the highest risk areas and to consequently focus a programme of forest management interventions, as well as location and capacity of fire fighting resources that are tailored to the results of the risk mapping. A high-resolution fire risk map is provided for both regional and local levels and is based on observations of past burned areas. The systematic detection and storage of each burned area allows for building a large and useful database for statistical analysis. Using these alongside land use/land cover maps allows clear identification of which kind of vegetation is more related with fire spread.

Many satellite services are readily available at the European level for detecting burned areas. The Joint Research Centre of the European Commission (JRC)'s European Forest Fire Information System (EFFIS) is also collecting burn scar maps. Combined with the various available European wide satellite land use/land cover maps, such risk mapping could be transferred to other fire-prone areas in Europe. In more general terms, the application of existing in situ and space-based earth observation systems, remote sensing and geographic information systems (GIS), in combination with weather, climate and hazard modelling and forecasting tools, is thus a GP measure that can be relevant for other hazard types and could be utilised throughout Europe.

Risk modelling

Yet another specific methodological approach is risk modelling. Risk modelling can focus on various different elements, such as prospective approaches to predict future risks, modelling for specific geographic scales such as urban risks, as well as the need to consider climate change impacts in risk assessments by carrying out specific climate risk modelling.

The importance of applying prospective risk modelling is highlighted by the Foresight Programme[71], which has helped the UK Government to consider and assess the future (20-80 years ahead) systematically by combining the latest scientific evidence with futures analysis. Improving Future Disaster Anticipation and Resilience is a new project under the Foresight Programme investigating how to improve anticipation of and resilience to disasters. It is expected that the final report of the project will be published by the end of 2012, identifying actions that could be taken within the next 10 years to reduce the impacts of disasters arising from hazards up to 2040. The project involves industry and academic expertise from the UK and explores how emerging science and technology might improve the ability to prevent, prepare for, and respond to disasters. The results of this research project will be translated into policy planning because the Foresight Programme is directly linked to the Prime Minister and Cabinet via the Government Office for Science within the Department for Business, Innovation and Skills. Further, the Foresight Horizon Scanning Centre ensures that relevant trainings, toolkits and networks are available to strengthen futures thinking capacity and share best practice within and across government, sectors, and other actors.

Recent years have furthermore shown the importance of incorporating climate risk modelling into overall planning processes, in particular for those sectors that interact with climate mitigation and adaptation. The Climate Change Act 2008[72] in the UK (HM66) for example, demonstrates such understanding because it created a framework for building the UK's ability to adapt to climate change, while at the same time improving DRM. The framework includes a UK wide climate change risk assessment that must take place every five years; a corresponding national adaptation programme to address the most pressing climate change risks the UK faces (also to be reviewed every five years); and a mandate giving the government the power to require bodies with functions of a public nature and statutory undertakers (e.g. water and energy utilities) to report on what they are doing to address the risks posed by climate change. Additionally, the Act established an Adaptation Sub-Committee of the independent Committee on Climate Change, whose role it is to offer guidance, analysis and information in relation to requests from national authorities for advice on adaptation, the preparation of the UK Climate Change Risk Assessment and the implementation of the national Adaptation Programme.

As with the other specific tools and methods portrayed in this section, it is essential that the results of risk modelling actually be used as a tool for planning. Two ongoing research projects reflect this importance. The main objective of the FP7 project MATRIX (New Multi-Hazard and Multi-Risk Assessment Methods for Europe)[73], running from 2010 to 2013, is to develop methods and tools to tackle multiple natural hazards with a common framework for risk assessment and analysis. This should allow future analysts and policy-makers to optimise and standardise the risk modelling process, which in turn should contribute to rationalising data management for hazards and vulnerability reduction, as well as support cost-effective decisions on structural and non-structural DRM measures following a multi-hazard, multi-risk perspective. Such improved methodologies for multi-hazard, multi-risk modelling should thus allow for cascading hazards, comparing risks and

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71 www.bis.gov.uk/foresight.

72 http://www.defra.gov.uk/environment/climate/government.

73 http://matrix.gpi.kit.edu.

improved informing of the planning process, as long as dissemination of the results to relevant communities and end users is ensured.

Similarly, the Global Earthquake Model (GEM)[74] was developed to bridge the gap between the increasing worldwide vulnerability to earthquakes on one hand, and the lack of reliable risk assessment tools and data in many areas on the other hand. The fact that there are no global standards that allow for the comparison of approaches to risk modelling and analysis is in juxtaposition to the fact that everyone needs to work together to better understand earthquake behaviour and consequences. GEM includes global projects, open-source information technology development and collaborations with more than ten regions, all to develop global datasets, best practice, toolkits and models for seismic hazard modelling and risk assessment, which will be available online through the web-based OpenQuakePlatform from 2014 onwards. This model was created due to the very need of governments and companies for tools to guide their decision-making and planning processes. With this tool, policy-makers worldwide will be able to calculate, visualise and investigate earthquake risk, capture new data and share findings for the exchange of lessons learned.

Construction codes

Another planning related GP for earthquake disaster risk management is the application of seismic design codes for new buildings and critical infrastructure. Italy, Greece, and Turkey, for example, all have building codes that can be considered GP cases. Seismic design codes for buildings and infrastructure represent one of the key hazard-specific measures for mitigating the risks of impacts from earthquakes. To this end, Eurocode 8 and other non-European codes in Japan and Chile for example, can be highlighted as good examples of stringent legislation. Within the suite of Eurocodes, Eurocode 8 (EQ13) applies to the design and construction of buildings and civil engineering works in seismic regions. Its purpose is to ensure that in the event of earthquakes human lives are protected, damage is limited, and structures important for civil protection remain operational.

Finally, building codes should not only address new buildings but also apply when retrofitting is carried out. Yet, not much progress has been made over the last years in terms of developing more harmonised guidance on vulnerability assessment and risk reduction via retrofitting of existing buildings. Nevertheless, if carried out appropriately, retrofitting existing buildings is deemed a particularly effective GP. European priorities should be developed for important buildings to formulate a common GP approach and corresponding rules.

Building design codes are also used as a DRM tool for planning purposes for other hazard types and should be improved to address the increasingly extreme weather events due to climate change. Ireland (FL54), for example, established guidelines on how to reduce vulnerability of buildings to flooding. Practical instructions on how to reduce damages in buildings of flood prone areas are included. According to experts, this type of guideline could quite easily be transferred to other countries or hazard types.

EWS and their role in prevention

EWS can play an important role in mitigating risk and informing the planning process. When looking at the prevention aspects of EWS, the GPs highlighted in this section showcase the organisational aspects of EWS rather than technical specifications. According to the United Nation Office for Disaster Risk Reduction (UNISDR)[75], a complete and effective EWS, considered as a prevention

[74] http://beta.globalquakemodel.org/gem/.
[75] http://www.unisdr.org/2006/ppew/info-resources/ewc3/checklist/English.pdf.

tool, comprises four elements: (a) risk knowledge; (b) monitoring and warning service; (c) dissemination and communication capacities; and (d) response capability. Good EWS have strong links between the four elements. Risk scenarios should be defined and reviewed periodically. A clear line of responsibilities throughout the chain should be agreed and implemented. Improvements to the EWS should be based on experiences and on the study of past events. However, they should be designed to easily adapt to the envisaged climate changes. Manuals and procedures should be published. Communities should be consulted and information disseminated. Operational procedures such as evacuations should be practiced and tested.

Among the supporting GPs, the 'Vigilance' system in France (HM13), for example, covers all four elements of early warning for hydrometeorological risks. The hazards are assessed at the meteorological inter-regional level (up to 25 départements) in close co-ordination with the National Forecasting Center (CNP). A strong role of responsibility is given to the inter-regional level. This GP shows the potential of a EWS that integrates different hazards within clear lines of authority and responsibility. This practice is also particularly good for two reasons: 1) a unique command structure is in charge of issuing alerts for all the hydrometeorological hazards and 2) the information reaches different stakeholder levels simultaneously, ranging from Préfets to the general public. Similar systems can be transferred to other countries even if EWS experiences across Europe are already quite common. What is of interest for transferability are the organisational structure and the co-ordination across different hydrometeorological risks. Similar multi-hazard systems exist also for other European countries (e.g. Italy).

An important topic for improving horizontal prevention efforts is integrating EWS into risk management plans (FL49) and in general into the governance system related to DRM. To this respect the Italian experience (FL51) shows how to define clear lines of responsibilities for a EWS intended in its broad sense. This topic also includes the question on how the available early warning information is actually used by the public. The Liguria Region (FL51) (Italy) after the devastating flash floods of autumn 2011 has recently started an interesting participatory approach for improving the response capability phase of early warning. The Italian system can also be considered a useful example of multi-risk EWS with excellence in forest fires and flood risk areas. Both the Italian (FL51) as well as the French (FL35) GPs represent not only efficient flood EWS but provide an interesting example on how these systems are linked with the national governance structures.

Forest Fire EWS in Germany (FF10) and Italy (FF13) represent yet another set of exemplary practices in early warning, especially with respect to their organisational set-up and their effective link with the local governance structures. The creation of official forest fire warning levels for the purposes of preventive fire protection is based on the daily forest fire danger warning. The officially binding forest fire alert level for each forest fire prediction region and a prediction of the alert level for the following days are provided to the institutions involved in fire risk management. Both these GPS present not only efficient EWS, but provide an interesting example on how these systems are linked with the local governance structures. It is possible to extend access of EFFIS forecasts to all European countries. In addition, most countries have a meteorological service able to run a Limited Area Model on a local scale and manage sensor networks to provide data input to EWS.

Furthermore, when dealing with early warning systems, the cross-border information exchange is important. The Meteoalarm project (HW4) gathers information on all existing national EWS and aims to communicate warnings across the participating MS. Citizens can access the portal and the idea is to also look into cross-border hazards, but currently even standards on how to warn citizens about a big storm, for example, are very different on both sides of the Rhine River (France versus Germany).

Although earthquakes cannot be predicted, the effects of a big earthquake in the areas surrounding the epicentre can be assessed by a dense network of seismic sensors once the source of the earthquake has been detected. A well-known example of an earthquake EWS in operation is Japan, where high speed trains running near the coasts are automatically stopped once the system detects seismic signals collected by ocean bottom seismometers. In this case, the time available between the first detection of an earthquake and the arrival of strong motion seismic waves at the populated areas is of the order of a few tens of seconds. Similar systems are also in operation or under development in some European countries like Turkey, France, Italy and Greece.

Another typical example of EWS is that concerning tsunami risk. Tsunamis are generated by strong earthquakes under the bottom of the ocean. In this case, owing to the lower velocity of sea waves in comparison to seismic waves, the time available for an early warning to the population is of the order of tens of minutes up to several hours, depending on the distance of the seismic sources from the coasts. This time is in many cases long enough for people to evacuate unsafe areas close to the coasts, moving towards higher areas. Tsunami warning systems are in place in such countries as Japan, the USA and New Zealand, as well as in European countries like Portugal (NEAREST), France (CEA/DAM), and Turkey (IERREWS).

The Integrated Observations from NEAR Shore SourcES of Tsunamis (NEAREST) in Portugal (EQ24) is an EWS prototype focusing on the identification and characterisation of potential tsunami sources located near shore in the Gulf of Cadiz via near-real time detection of signals by a multi-parameter seafloor observatory. NEAREST interacts with climate adaptation in the light of climate change impacts and decision-making under long-term uncertainty. It highlights the importance of establishing clear mechanisms for co-ordination across scales and sectors, including information flows and engaging a wide range of research institutes, universities, scientific communities, and stakeholders at the national and international levels. NEAREST has been developed for multi-hazard risk assessment, such development and implementation of disaster management and seismic risk reduction, ensuring a more integrated approach to emergency response. The objective of the Tsunami Warning Centre for the Western Mediterranean and North-eastern Atlantic (CEA/DAM/DIF) (EQ38) in France is to provide, in less than 15 minutes, the first information concerning potentially tsunami-genic earthquakes. This centre implies two special challenges: to develop a very fast, powerful and robust system for processing this geophysical data in real time, so that within a few minutes it is possible to characterise an earthquake and its tsunamigenic potential; to set up and maintain standby duty personnel, i.e. experts present at the CEA/DAM/DIF centre around the clock, to treat the events of interest. The future warning centre would have to alert not only the French civil protection authorities, but also the services concerned in countries bordering the Western Mediterranean and North-eastern Atlantic (Spain and Portugal). The Istanbul Earthquake Rapid Response and Early Warning System (IERREWS) (EQ11) has been in operation since 2001 and consists of 100 free-field accelerographs stationed in dense settlements in the metropolitan area of Istanbul in dial-up mode for rapid response information generation. The EWS consists of 10 strong motion instruments, installed in the Marmara region at locations as close as possible to the Marmara fault, in online data transmission mode to enable earthquake early warning. Public institutions have been involved in the project, guaranteeing the continuity of financial support and thus sustainability of the measure. IERREWS comprises a robust response system, whose purpose is the rapid processing and broadcasting of information about the distribution of ground-motion parameters relevant to structural damage. It appears to have clear lines of organisation both vertically between scales and horizontally between sectors, and good communication and co-operation among public stakeholders. IERREWS will be further expanded to the regional scale (Marmara Region) and significantly improved, in terms of the quality of the warning information provided, by a new project “Earthquake Disaster Information System for the Marmara Region” (EDIM) funded by the German Federal Ministry of Education and Research.

IERREWS illustrates the capacity for effective integration to be undertaken at the sub-national level. It highlights the importance of establishing clear mechanisms for co-ordination across scales and sectors, including information flows and engaging a wide range of public stakeholders and data collection at the national and international levels. IERREWS has been developed for multi-hazard risk assessment, such as the development and implementation of disaster management and seismic risk reduction, ensuring a more integrated approach to emergency response.

To conclude, GPs in specific assessment methods and tools portray the following key characteristics:

- Specific technical tools can aid the risk assessment procedure and refine its accuracy. These include, for example, micro-zoning, hazard mapping, risk modelling, construction codes, remote sensing, geographic information systems, as well as *in situ* and space-based earth observation systems:
    - Land use planning guided by regularly updated risk assessments can help increase resilience by appropriately citing critical infrastructure and housing outside of high risk areas;
    - Building codes can serve as a key tool for directing planning for greater resilience. Practices applying strict building codes based on local risk assessments are in line with HFA priorities on encouraging the revision of existing or the development of new building codes, standards, and reconstruction practices, as well as reinforcing the capacity to implement, monitor and enforce such codes.
- When considered as a prevention tool, EWS should comprise knowledge on the risk, i.e. be linked to detailed risk assessment, include an operational monitoring and warning service, have well-functioning dissemination and communication capacities, and possess sufficient response capability. National, regional and local EWS systems could benefit from EU guidelines regarding minimum requirements for these components;
- EWS must be sufficiently location-specific so as to be sensitive to cater to the population they intend to warn, i.e. understandable communication taking into account culture, livelihood characteristics, gender, etc.;
- Institutions must have the capacity to ensure that EWS is firmly integrated into the planning and decision-making processes at all levels of government, ideally via a well-functioning vertical governance structure for DRM;
- The effectiveness of EWS is highly dependent on the functioning and continuous improvement of databases and the sharing of access to data and information between all levels of government within one country, cross-border and internationally.

4.2.4 *Risk prevention proofing of new investments and integration of DRM into post-disaster recovery actions*

One set of financing options for planning purposes revolves around climate proofing new investments. Another related financing measure is the integration of DRM into post-recovery actions. GPs around Europe show that these mechanisms, if firmly integrated into the planning process, can steer new investment toward improving DRM and prevention activities in particular.

Risk prevention proofing of new investments

The HFA 'priorities for action 2005-2015' include the mainstreaming of disaster risk considerations into planning procedures for major infrastructure projects. GPs in Europe also show a clear potential for the EU to play a role in steering its investments towards mainstreaming disaster prevention considerations for new infrastructure and/or development projects. Essentially, this means that the EU would ensure all its investments, whether they include co-financing projects,

State Aid or investments via Structural Funds, etc., will not be increasing disaster risk, and if possible will include components for preventing risk.

Such 'prevention-proofing' of investments can be ensured via relevant criteria for design, approval and implementation of new programmes, projects or funding streams. For example, the use of Cohesion Policy funds for risk prevention offers a means for guiding investments, in this case co-funding, to where the immediate consequences of disasters are typically felt: at the local and regional levels and their authorities. As such, risk prevention fits well within the overarching goals of Cohesion Policy, which includes the preservation of socio-economic development and capacities as well as the maintenance of territorial cohesion and the preservation of public goods (infrastructures, ecosystems, health system, etc.).

Already, in the current programming period (2007-2013), 30% (amounting to EUR 105 billion) of the total co-financing budget is allocated to the environment, of which EUR 7.3 billion is dedicated to risk prevention measures under the environmental services and infrastructure theme[76]. When looking at this share of risk prevention versus total allocation per MS, Malta and Hungary used by far the highest percentage of funding for risk prevention, 7.3% and 5.3% respectively[77]. A similar percentage of cross-border co-operation measures funded under INTERREG IVC programmes focused on risk prevention. The ongoing programming period furthermore reinforces risk prevention as a priority in the European Regional Development Fund (ERDF) regulation and the European Social Fund (ESF) can also support capacity building on risk prevention. Additionally, the Community Strategic Guidelines 2007-2013 encourage giving priority to the "protection against certain environmental risks (e.g. desertification, droughts, fires and floods)"[78].

Despite this encouragement for engagement in risk prevention measures, 80% of the initial funding under the risk prevention theme is still available and thus there is substantial room for new prevention projects co-financed by the Cohesion Policy. Projects that are being implemented under the risk prevention theme include, for example, flood and drought prevention via re-naturalisation of watercourses and wetlands in Poland, which in turn should minimise this risk and prevent droughts. Another ongoing project is INTERREG's Green and Blue Space Adaptation for Urban Areas and Eco Towns (GRaBS) project, which developed a database of 15 case studies from cities acting on adaption to climate change[79].

Some of the thematic objectives of the proposal for the 2014-2020 programming period of the Cohesion Policy funds include the promotion of climate change adaptation, risk prevention and management. Example projects could include: ecosystem-based adaptation, new city planning and development such as green roofs, public spaces and water recycling, as well as technological innovation projects[80].

While the Cohesion Policy funds demonstrate how to leverage funding streams for encouraging the creation of projects focusing on risk prevention, other EU level instruments can be leveraged to ensure that decision makers consider the ensuing disaster risk impact when deciding whether to proceed with an investment, namely the environmental impact assessment (EIA) and strategic

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76 European Union Regional Policy. Use of Cohesion Policy funds for prevention of natural disasters. Presentation by Mathieu Fichter, Policy Analyst Environment, Regio D2 – Thematic Coordination.

77 European Union Regional Policy. Use of Cohesion Policy funds for prevention of natural disasters. Presentation by Mathieu Fichter, Policy Analyst Environment, Regio D2 – Thematic Coordination.

78 http://ec.europa.eu/regional_policy/sources/docoffic/2007/osc/index_en.htm.

79 European Union Regional Policy. Use of Cohesion Policy funds for prevention of natural disasters. Presentation by Mathieu Fichter, Policy Analyst Environment, Regio D2 – Thematic Coordination.

80 EC, 2012. EU Cohesion Policy 2014-2020: legislative proposals, can be accessed via: http://ec.europa.eu/regional_policy/what/future/proposals_2014_2020_en.cfm.

impact assessment (SEA) Directives. These have already been firmly established as an integral part of the planning and decision-making process regarding new investments throughout Europe. The projects and programmes co-financed by the EU (e.g. Cohesion, Agricultural and Fisheries Policies) have to comply with the EIA and SEA Directives to receive approval for financial assistance. Thus, the Directives are crucial tools for providing strong impetus on how prevention practices on a national or regional level are being directed[81].

Also, the EU could give support and assistance on how MS could build this type of guidance into European funding programs.

This type of mainstreaming exercise would also offer an excellent opportunity to link risk reduction and climate adaptation measures. The Red Cross Red Crescent Climate Centre has recently published a proposal for 'Minimum Standards for local climate-smart Disaster Risk Reduction – enabling integration of local capacities into national climate adaptation strategies'. In this document, a similar minimum standard on mainstreaming is proposed: new programmes should consider a level of 'acceptable risk' in project design, including physical infrastructure, and incorporate predicted trends in climate change into project plans.

Integrating DRM into recovery actions

In the rehabilitation and recovery phase of the disaster management cycle, it is important to address underlying vulnerabilities that had previously prevented safe construction and therefore limited durability and sustainability of infrastructure. To this end, emphasis should be placed on building-back better actions, such as improved infrastructure that will be more resistant to future events, or the relocation of infrastructure to safer areas. For example, incorporating earthquake-resistant construction elements, such as bracings and struts, can reduce future earthquake risk of buildings. Such 'build-back better' approach is demonstrated for example in Italy on a regional level, where the province of Catania implemented guidelines for the repair, improvement and reconstruction of damaged buildings following the eruptions and earthquakes that occurred on 27 and 29 October 2002 (EQ62). These guidelines cover the minimum measures to be accomplished in terms of repairing damages and ensuring seismic improvement and adjustment of buildings in order to increase resilience to future earthquakes. The guidelines are based on micro-zoning studies carried out in the region to evaluate local amplifications. On an international level, the Green Recovery Partnership represents an example of GP. During the recovery phase post-2004 South Asian Tsunami, the World Wildlife Fund (WWF) has been working in partnership with the American Red Cross to ensure that reconstruction activities maintain and enhance ecosystems. This includes, for example, the restoration of livelihoods, the construction of homes and other structures based on sound spatial planning, and the restoration of water systems for water and sanitation[82].

Such an approach of 'building-back better' in the recovery phase after a major disaster has also been endorsed by the EU Council, which in its Conclusions on Innovative Solutions for Financing Disaster Prevention "acknowledges that linking EU financial assistance to an obligation to introduce preventive measures designed to limit damage and to avoid, to the extent possible, a recurrence of similar disasters would enhance the cost-effectiveness of such funding"[83].

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81 EC Review of the Environmental Impact Assessment (EIA) Directive. (http://ec.europa.eu/environment/eia/review.htm).

82 UNEP & ISDR, 2009. Reducing Risk through Environment in Recovery Operations: An Initial Review of the Status. (http://postconflict.unep.ch/publications/UNEP_DRR_01.pdf).

83 Council of the EU, 2010. Conclusions on Innovative Solutions for Financing Disaster Prevention (http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/jha/117557.pdf).

To conclude, collected GPs for this topic share several key features:

- Mainstreaming disaster risk considerations into all new EU investments, i.e. including selection criteria for evaluating disaster risk impact during the application process for future infrastructure and development projects, as well as funding programmes that could help avoid unintentionally increasing risk and vulnerability:
  - The latest proposals for the new Cohesion Policy funding period as well as proposed revisions to the EIA Directive have already incorporated this line of thinking.
- Mainstreaming risk considerations into evaluation grids for new investments can be combined with similar mainstreaming criteria for climate awareness;
- "Lessons learned" actions in the recovery and reconstruction phase represents an essential building block for reducing future vulnerabilities and fostering more resilient communities. The 'build-back better and greener' approach to recovery has proven extremely effective in various GPs reported.

4.2.5 *Financing mechanisms, including risk transfer and private sector involvement*

Financing mechanisms are intricately linked to planning processes in two ways: on the one hand, planning for policies and measures heavily depends on the type of financing it is backed by; and on the other hand, linking planning for DRM directly to financial incentives triggers a more prevention-focused behaviour, thus increasing resilience and indirectly decreasing financial and insured losses that would otherwise be experienced in the event of a disaster. The latter is commonly referred to as risk transfer whereby costs are associated with what the government has done regarding prevention prior to the hazard event, but also how the private sector (insurance) can provide the right incentives such as risk premiums.

Linking risk assessment and financing issues

The recent G20/OECD methodological framework publication[84] depicts the important links between risk management planning and financing issues. First of all, the development of effective risk financing strategies at the national level, as with many other components of DRM, depends on the quality of risk assessment because it requires a thorough understanding of risk exposures and consequent financial vulnerability. Such risk assessment and establishment of the financial situation then represents a point of reference for assessing costs and benefits of ex ante versus ex post disaster financial tools. As the quality and quantity of data increases, a wider variety of financial options become available. Furthermore, the G20/OECD methodological framework also encourages factoring risk assessment into overall financial strategies, to ensure the appropriate allocation of resources for targeted ex post investments in risk reduction measures and 'build-back better' upgraded infrastructure. At the same time, financing mechanisms and risk transfer can also reinforce risk assessment and support other components of DRM, because private insurance companies have strong incentives to perform their own risk assessments and thus generate updated data on hazards, exposures and vulnerabilities. Under public-private partnership setups these data will then be shared with governments and will in turn be able to support national risk assessments.

Risk insurance and risk transfer

MS are exposed to different types of disaster risks, resulting in a highly diverse insurance market across the EU. Nevertheless, the insurance system in Spain (HM48), which is based on the principles of "compensation", "solidarity" and "co-operation", has been pointed out as a potential example to be followed. The first of these principles takes the form of a multidimensional

[84] OECD, 2012. G20/OECD methodological framework on disaster risk assessment and risk financing (http://www.oecd.org/mexico/g20oecdframeworkfordisasterriskmanagement.htm).

compensation, as it applies to: 1) all the hazards covered in general; 2) all of the geographical areas of the national territory, independent of their varying vulnerabilities to the range of natural hazards covered; and 3) a period of time which, given the nature and behaviour of catastrophic natural risks, should be considered from a broad technical/insurer perspective (compensation time frame). Under the principle of "solidarity", all of the insured (in the branches included in the system) contribute, in proportion to their respective insured capital, to the endowment of a common fund available to those of the insured who may be affected by the natural hazards covered. The principle of "co-operation" refers to the understanding and co-operation between the private market and the 'Consorcio de Compensacion de Seguros' (a government institution classified as a public business entity, attached to the Ministry of Economy and Finance) in the development and application of the system of cover.

With respect to the cover of extraordinary risks, the objective of the Spanish system is to compensate for losses produced by extraordinary events that occur in Spain and cause damage to people or property located within the country. Personal injury from events occurring abroad is also covered. Events covered can be of two kinds: those relating to natural perils (extraordinary floods, earthquakes, tsunamis, volcanic eruption, atypical cyclonic storms and the fall of meteorites) and those of a political/social nature (terrorism, etc.). The Spanish system is characterised by legally defining the danger it covers and it does so by considering the potential loss that such events are capable of generating in terms of their nature, frequency and intensity. With its penetration rate of 100% regarding the ordinary policies issued in the market, the Spanish disaster risk insurance system provides an example of a risk insurance coverage that covers a wide range of natural hazards, that legally defines the dangers it covers (so the nature of the event and not the amount of the damage caused is taken into account), and that defines losses as direct damage caused to people/property and business interruption as a consequence of disaster. Moreover, it does not require the official declaration of "disaster" or "disaster area" – cover is automatic for the hazard covered once the event has occurred, provided that the party affected meet the insurance terms and conditions. As such, it appears to represent a solid base for establishing common ground in disaster risk insurance in the EU.

Similarly, national solidarity in the face of disasters has been constitutionally acknowledged in France (HM16), with the assumption of the equality and solidarity of all citizens in relation to the burdens arising from national calamities. The system for indemnification of natural catastrophes combines the solidarity inherent to mutualisation (the basis of the institution of insurance) – in relation to a given risk and through payment of a premium - with the principle of national solidarity via the guarantee granted by the State. The natural catastrophe coverage system contains three fundamental elements: 1) a policy of generalisation of guarantees, through direct insurance; 2) a policy of State backing via reinsurance by the Caisse Centrale de Reassurance (CCR) with unlimited State guarantee; and 3) a natural catastrophes prevention policy. Right of indemnification is supported by two basic assumptions: 1) in relation to the suffered loss, the claimant has contracted insurance – which remains in force – for property damage; and 2) the government declares a natural disaster, in an inter-ministerial decree.

The Belgian system (HM3) inspired by the Spanish and French models, is governed by the principle of solidarity, which the country's legislators intended to be applied indivisibly with another, that of prevention, which must be respected equally by insurers and public powers, and those insured. This means that insurance mechanisms do not operate efficiently if those insured, potentially affected by natural disasters, do not take the precautions within their reach, or the authorities abandon their role in the realm of risk-mitigation in the field of both structural and non-structural measures. The system combines the solidarity amongst those insured (all paying for the cover, irrespective of the level of risk), the solidarity amongst insurers (who must participate in the Caisse

de Compensation) and the solidarity amongst citizens (the State is the ultimate guarantor of the system).

The heterogeneity of disaster risk situations among different EU countries explains the diversity of insurance solutions and of specific systems for covering natural catastrophes that exist in MS. It might lead to the conclusion that no "one size fits all" insurance scheme is appropriate for the EU, but there is certainly a role for the EU to work on introducing some risk insurance standardisation products and processes across the EU, such as harmonisation of the post-disaster assistance policies and education and public information campaigns in relation to insurance.

Regarding potential future use of guidance on risk insurance, ideas presented in this study could be fed into the Green Paper on insurance and disasters issued by the Commission in early 2013. One of the key issues to consider would be how to use insurance risk premiums as an incentive for disaster prevention measures. The adoption of risk-based premiums could be considered because they might reduce the moral hazard and thus lead to a better understanding of the development of risk. In the USA, the national flood insurance programme is voluntary and connected to mitigation measures. Citizens have to commit to mitigation measures to lower their premium if they want to be insured. One of the points for guidelines to focus on would be to explore ways to encourage the use of disaster risk insurance policies, with risk premiums to foster prevention measures. This should be combined with organising effective consumer education and public information campaigns.

Opportunities for public-private partnerships

Complementary to the above, "responsibility sharing", wherein various stakeholders (i.e. governments, private companies, insured parties) all take part in minimising and adapting to catastrophic environmental conditions, might be promoted as one out of three overarching core principles of efficient insurance schemes. This approach has been proposed by the European Insurance and Reinsurance Federation (CEA). The other two principles are "co-ordinated action" and "ex-ante financing". While insurance policyholders are responsible for small scale mitigation and adaptation measures, the co-operation from public authorities who are responsible for investment in general prevention measures makes a significant difference in the level of insurability for natural catastrophe risk.

The GPs presented throughout this section have shown clear opportunities for public-private partnerships and the important role that the private sector, namely insurance companies, can play for financing disaster prevention. Such public-private partnerships can offer clear cost advantages via risk transfer and risk pooling for large disasters of uncertain probability, which otherwise may make prevention prohibitively expensive for individual national authorities, regions or localities. The public-private co-operation between national governments and insurers also brings benefits for other aspects of DRM, such as an improved ability to model risks, identify effective policy measures, and offer incentives to households, industry and infrastructure managers for integrating prevention considerations into their decision-making[85].

At the same time, this section also showed the wide diversity of current financing mechanisms in Europe and various suggested approaches and ways forward regarding risk insurance, public-private partnerships and incentives for greater emphasis on prevention. In order to continue to foster such creativity and diversity in finding the best possible way forward, there is a need for finding innovative instruments for the financing of disaster prevention, and overall DRM activities in

[85] Council of the EU, 2010. Conclusions on Innovative Solutions for Financing Disaster Prevention (http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/jha/117557.pdf).

more general. Such fostering of innovative solutions is supported by the Council Conclusions on Innovative Solutions for Financing Disaster Prevention presented in November 2010.

To conclude, GPs in financing mechanisms revolve around risk insurance and public-private partnerships. Collected GPs for this topic share several key features:

- Like many other elements of DRM, effective and cost-saving financing mechanisms also need to be firmly linked with risk assessments. Risk analysis can guide financing policies to foster the right balance between ex ante and ex post disaster financing schemes;
- A risk insurance system covering multiple-hazards is preferable to a single-hazard based system as it provides greater societal reassurance and can spread costs across more actors;
- Pay-out independent of official disaster declaration can help alleviate immediate needs among the population;
- Financial incentives for disaster prevention measures at all levels of government and from the private sector helps shift the focus from response and recovery to prevention, in particular for buildings and critical infrastructure;
- Public-private partnerships for risk transfer under the principle of solidarity build a solid basis for functioning risk insurance systems;
- 'Responsibility sharing' for prevention measures between stakeholders is an important step towards affordable insurance.

4.3 Risk communication: awareness raising, education and capacity building

Effective DRM hinges on the ability of stakeholders and general public to translate policy and information into action. For authorities to handle disaster risks such as earthquakes, floods and storms, the interpretation of data and risk levels requires technical knowledge and/or experts to provide analyses that are accessible for non-experts. Moreover, as noted in the Commission's Communication on Disaster Prevention (COM(2009) 82), the general publics' understanding of disaster risks and how to prevent them is essential to ensuring the successful implementation of policies:

- The integration of information and capacity building into DRM also corresponds to international obligations in the HFA priority for action no. 3. It emphasises the need to use knowledge, innovation and education to build a culture of safety and resilience at all levels. HFA states: "*Disasters can be substantially reduced if people are well informed and motivated towards a culture of disaster prevention and resilience, which in turn requires the collection, compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities*";[86]
- To properly integrate information and capacity building for citizens and authorities, practical examples are needed to identify GP of both conventional and unconventional methods. While mainstreaming of DRM in school curricula is an example of a well-known instrument for raising awareness for DRM, emerging technologies such as smart-phones and the use of social media may unlock innovative and unexplored approaches to DRM.

The following sections present a range of examples found in Europe of GPs in information and capacity building in DRM. Each section ends with a brief analysis of the common characteristics of the practices. The availability of information and raising public awareness, then the capacity building of professionals, are analysed.

[86] UNISDR, 2006. Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters.

4.3.1 *Availability of information and public awareness raising*

The availability of information and public awareness of how to prevent and react when disasters occur are important elements in DRM. The collection of GPs made for this study shows three key elements which are elaborated upon in this section: (1) information should be tailor-made to its audience and context; (2) participatory approaches are useful to create buy-in and accommodate viewpoints; and (3) internet and social media have become indispensable tools for making information available for a large number of people and should be used to the fullest.

Tailor-made information

Good examples of successful awareness raising campaigns collected for this study tailor their information campaigns to their audience. What is more, they often have a participatory character, meaning that representatives from target audiences and other stakeholders are involved in planning, executing, monitoring and evaluating the campaigns. It could foster mutual understanding of the needs and wants among authorities and target groups. An example of such an approach with both elements – tailoring and participatory – can be found in France. The Memo'Risks (HM12) initiative has operated in the Loire River catchment area in France since 2004. The project gathers local governments and schools to survey local disaster risk awareness. Students, encouraged by city Mayors, investigate the possible hazard impacts on their town, map risks, and survey the preparedness and risk knowledge of the local population. After the project is over, the survey results gathered are used to understand perceptions of risk, raise awareness through media, and assess the level of risk knowledge in the local population. Memo'Risks highlights how the process is equally important to the end-result in DRM.

Education targeting school children is an important and common practice in EU MS. There are numerous good examples on both multi-hazard prevention and awareness raising that target specific hazards. In Sweden (HM54), schools are offered comprehensive and quality assured materials that can be used in teaching emergency preparedness and protection against accidents. The Swedish Civil Contingency Agency (MSB) also provides educational and experiential role-play for schools, such as "Black Out", which highlights the consequences to different parts of society and how individuals are affected by a prolonged power outage. The MSB has a specific mandate to update and broaden the existing material and to conduct a special communication effort to all of the country's 18-year-olds to increase knowledge and awareness of defence and emergency preparedness. Moreover, the American Red Cross for example, provide a "Masters of Disaster" curriculum with a series of readily implementable lesson plans to support both organisations and parents to educate children about disasters and risk. The curriculum is adapted to national education standards and concentrates on lower elementary (levels K–2), upper elementary (levels 3–5) and middle school (levels 6–8) classes. The lessons are intended to integrate disaster awareness with general school subjects such as maths, language and science while using interactive and "fun" sessions. Finally, the curriculum is meant to help children prepare for the possible repercussions and traumas connected to disasters87. Also in Hungary (HM21), under the co-ordination and guidance of the Hungarian Platform for Disaster Reduction (NDGDM), the disaster management preparation of teachers and youth carried out over several years will be put into law. In order to concentrate the different fields of public awareness, institutionalise tasks, systematise conscious and bottom-up knowledge, an action plan for the preparation of children and youth has been elaborated. In Italy, a project developed for EDUcational itineraries for RISK reduction (EDURISK) (EQ77) was founded by the National Group for Protection against Earthquakes (GNDT) and is backed up by the National Department for Civil Protection. The project aims to bring experts together with people from different backgrounds and knowledge-levels.

[87] American Red Cross, 2012. Become a Master of Disaster. (http://www.redcross.org/prepare/location/school/preparedness-education).

Experts are therefore better positioned to prepare information in an accessible and easily understandable way, depending on age, education and knowledge on the topic, to assist people becoming acquainted with seismic and volcanic risk and how to reduce vulnerability. They defined tools for different target groups based on age (infant, primary, lower and higher secondary school) to provide the information in an accurate way. Subsequently, the material was tested in several schools and the results were evaluated. Similar projects are ongoing in Poland for floods (FL69) and Spain for forest fires (FF34). The Spanish initiative, for example, is embedded in a larger project with three different types of campaigns: rural population campaigns (focused on rural areas with a high number of fires), school campaigns; and media campaigns (TV, radio and paper spots).

Information campaigns and awareness raising could also target vulnerable groups in society, such as older citizens, children and women, homeless and handicapped people; occupational groups such as journalists and business; and other groups such as tourists.

The Red Cross/Red Crescent's Climate Centre, for example, recognises the urgency for increasing resilience of the most vulnerable communities by launching a minimum standards programme, intended to strengthen local "climate-smart" DRM. It recognises that local conditions and knowledge needs to be utilised and understood to improve effectiveness. On a more practical level, vulnerability reduction in the Loire basin in France that focuses on flood prevention in residential areas and trading estates highlights the need for a vulnerability analysis of these areas and how it can be coupled with awareness raising. In the practice, building owners would receive a vulnerability analysis of their houses, for example a photomontage illustrating the potential level of water in the case of flooding, and a list of recommended actions to prevent damage. Targeting the vulnerable parts of infrastructure and the participative element of the practice (see next section) makes it more likely that the building owner will take action to prevent damages to their dwelling or enterprise[88].

Children are among the most vulnerable in society and require particular attention with regard to the psychological aspects of disasters. In Slovenia, the national civil contingency agency has launched national awareness raising and information campaigns targeting the wider community, but in particular children, via educational activities[89].

Tourists visiting disaster prone areas are also considered a vulnerable group in society, given their lack of local knowledge, therefore requiring tailored information. The United Nations Environment Programme (UNEP), together with a number of national civic contingency agencies, in the context of the Awareness and Preparedness for Emergencies at Local Level (APELL) programme (IR 62), have developed a tool-kit for planners and emergency managers on how to deal with tourism and DRM. The objectives of the tool-kit were to raise awareness and capacitate authorities and communities in identifying, assessing, planning and managing risks related to areas for tourism[90].

Journalists have a special role to play in the case of emergency and prevention. Research suggests that long-term reporting on disasters and press coverage of events increases awareness and the likelihood of preventive action. Media also play an important role in translating technical knowledge to layman's speech. The role of media, however, is not unproblematic given that the drivers of newsworthiness, the political stance of editors and the need for dramatization may "frame" DRM in

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88 Höppner, C, Bründl, M and Buchecker, M., 2010. Risk Communication and Natural Hazards. CapHaz-Net WP5 Report, Swiss Federal Research Institute WSL. (http://caphaznet.org/outcomes-results/CapHaz-Net_WP5_Risk-Communication.pdf).

89 Ibid.

90 UNEP, 2008. Disaster risk reduction: a tool-kit for tourism destinations, practical examples from coastal settlements in Asia. (http://www.uneptie.org/shared/publications/pdf/DTIx1116xPA-DisasterRiskReductioninAsia.pdf).

non-productive ways[91]. The need to provide journalists with the appropriate tools and knowledge to support disaster prevention exists. A number of examples of GP in this respect can be found. Polish authorities (IMGW, 2003), for example, have released a handbook for collaboration with the media that is a publication for journalists entitled "Natural hazards" and the general idea is how to apply "user friendly" definitions within information provided to the public. It also updates journalists on the actions and activities of the IMGW (HM38). On an international level, in 2010 – 2011 the UNISDR, in collaboration with Thomson Reuters and funded by the Commission, provided training for journalists on how to report on disasters and promote DRM via media[92]. Moreover, a guide was developed for journalists reporting on disasters entitled "Disasters through a different lens: Behind every effect, there is a cause". It guides journalists on how to use language and reporting as a way to foster a culture of resilience and prevention in the spirit of the HFA[93].

Finally, preparing communities for seasons when disaster risks are more common may be beneficial. In the UK, for example, the 'Get ready for winter' programme was launched nationally to prepare citizens for different situations in cold weather such as what to have at home or in your vehicle. The programme is co-ordinated by the national authorities and involves a broad range of partners from voluntary organisations, water companies and government agencies.

This section has described campaigns that target communities, social and occupational groups and the business sector, to improve the uptake and delivery of disaster communication. Often these campaigns could benefit from being planned and implemented in a participative manner involving the targeted groups.

Participatory approaches – planning & knowledge transfer

The use of participatory approaches, where the public is able to express their opinion and influence decision-making, could be highly beneficial to create ownership, understanding and foster knowledge exchange in DRM.

First, participation in the early stages of planning and collaborative information creation in DRM appears to be beneficial for fostering a culture of resilience and disaster awareness among stakeholders. In France (DR4), the creation of drought and water scarcity management plans, for example, enables water users, farmers and the industry as well as regional and local authorities to be involved at the planning stage and create dialogue and understanding of the different needs and wants of all water-usage stakeholders. Participatory approaches currently appear to be used in the planning and mitigation of industrial risks more than in any other hazard areas – however, it should be noted that under the Seveso Directive, this is a legal obligation. In France, the involvement of the local council in risk prevention decision-making is codified in the Bachelot Law. The law ensures a certain degree of public participation in decision-making that concerns the development of hazardous plants. The law also includes an obligation to inform citizens about the decision made. The law is instituted by the Commission de Suivi de site, which is formed by the Prefect and is composed of representatives of the public population, industrial owners, local authorities and State. The objective of this committee is to gather those concerned by industrial risks in a particular area to hold a dialogue for seeking solutions to lower these risks. Similarly in Italy (IR30) following the Seveso II Directive and law D.lgs. 238/05, the participation of all stakeholders in the decision making process and in particular the general public, is required. The Mayor prepares the preventive

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91 Höppner, C, Bründl, M and Buchecker, M., 2010. Risk Communication and Natural Hazards. CapHaz-Net WP5 Report, Swiss Federal Research Institute WSL. (available at: http://caphaznet.org/outcomes-results/CapHaz-Net_WP5_Risk-Communication.pdf).

92 See for example: http://www.preventionweb.net/english/professional/maps/v.php?id=27689.

93 UNISDR, 2011. Disaster through a different lens: Behind every effect, there is a cause. A guide for journalists covering disaster risk reduction. Available at: http://www.preventionweb.net/files/20108_mediabook.pdf.

information campaigns for the population. Adequate information makes the population aware of preventive self-protection measures as well as actions to take in the case of accidents. The effectiveness of the information campaign is measured in terms of the ability of people to work with rescuers and to properly implement the emergency message pre-established during the campaign. It is therefore necessary, when planning, to determine the content of messages to forward during an emergency and the manner in which these will be released.

Beyond Europe, UNEP (IR62) focuses on the local preparedness of industrial accidents and natural disasters. The strategy of APELL is to identify and create awareness of risks in an industrialised community, to initiate measures for risk reduction and mitigation, and to develop co-ordinated preparedness between the industry, the local authorities and the local population. Any party can initiate the APELL programme, although companies are expected to take the lead. Governments or industry associates can facilitate it however this may be done by a broad field of partners and is not limited to certain actors. The communication during the preparation phase and the long record of successful application in different countries could be regarded as evidence for this programme's robustness and it is clearly easily transferred (e.g. in China, South Africa, Colombia, the Netherlands, and France). Nevertheless, vital and extensive communication between the individual participants is a precondition for success.

Another important aspect of participatory phenomena is volunteering. While there are many GPs of volunteering in Europe, the German Lifesaving Society (DLRG) may serve as a role model. The organisation's main objectives related to disaster prevention are to provide water safety information, swimming lessons and organise water rescue services. It engages more than 55 000 volunteers (2009) and co-operates closely with authorities, rescue services, police, military and other voluntary organisations. DLRG has been highly involved in flood prevention by training citizens and monitoring activities. It shows how voluntary action can be large, widespread and effective on both vertical and horizontal scale.

Finally, in the UK, Flood Awareness campaigns have been launched after experiencing devastating floods in 2007(FL95). The campaigns are instigated on a central and national level by the Environmental Agency, but invite local stakeholders to engage in the planning and implementation of these campaigns. The campaigns can be characterised by vertical co-operation and networking between different administrative levels and the public. The aim is to have people accept that (flood) risks exist in their close environment and inform them of the possibility for future risks. It consists of several collaborative approaches. First, communicators and flood risk managers collaborate and there is intense communication between different administrative levels. Second, the participatory approach meant inclusion and collaboration amongst individuals, businesses, schools, farms and whole communities. The active involvement of target groups in the design, conduct and review of educational activities was necessary to root prevention mechanisms more firmly in people's consciousness and hence make these more sustainable.

Dissemination and sharing of information

Information can be disseminated through various media outlets such as television, radio, newspapers, booklets and the Internet to raise awareness. With the rise of the Internet, social media and technologies such as smart phones and tablets, DRM has been given a new arena and tool for spreading information and launching awareness campaigns.

GPs for on-line information sharing can be found all over Europe and across hazards. In Sweden (HM54) for example with web sites such as "dinsäkerhet.se", "säkerhetspolitik.se" and "krisinformation.se" and the Netherlands (HM29) with mass media campaigns for how to act in

emergencies (www.nederlandveilig.nl/noodsituaties) and the publication of risk-maps (www.risicokaart.nl).

Internet portals for information on flood prevention are available in several EU MS, for example Hungary (FL18), the Czech Republic (FL25), Ireland (FL59), and Italy (FL104). They provide information on water levels, flood warnings, hydrological characteristics, and flood plains. Furthermore, the public can view insights in digital flood management plans, as well as historic and predictive flood mapping. In general these portals provide guidance on how to prepare for different hazards and how to act in certain situations. A similar approach can be found in the United Kingdom (HW29) regarding heat waves. The Heat Health Watch System (HHWS) on the Met Office Internet portal in the UK comprises of four colour-coded levels of response, based upon threshold maximum daytime and minimum night time temperatures. It runs during the summer and assesses the risk for heat waves and heat strokes and advises people on appropriate measures to take for each colour code.

The creation of the UNISDR's PreventionWeb[94] facility demonstrates the current advantages and future potential of information and communications technologies (ICTs) in information sharing for international DRM across scales. Built on the experience of ReliefWeb, the facility has been operating since 2006, with the goal of becoming a single entry point to the full range of global DRM information. This includes providing a common platform for institutions and actors to connect, exchange experiences and share information on DRM, as well as facilitating the integration of DRM with climate adaptation and wider sustainable development processes. The website functions as a crucial information tool for supporting the implementation of the HFA. In order to offer these services, PreventionWeb is updated daily, contains ongoing news, event calendars, online discussion forums, contact directories, reference documents, trainings, guidance on terminology, country profiles and fact sheets, and audio and video material[95]. PreventionWeb also links to the EU's CLIMATE-ADAPT portal. The European Climate Adaptation Platform[96] is a publicly accessible, web-based platform, designed to support policy-makers at EU, national, regional and local levels in the development of climate change adaptation measures and policies.

Moreover, web-applications, social media and the spread of technology such as smart phones allows for new and innovative approaches to be launched. In Sweden, for example, a recent experiment involved the use of a smart-phone application called BRANDRISK Ute, to update citizens of forest and grass fire risks in a particular area[97]. Users can download the application for free via the Internet and then by using the phone's global positioning system (GPS), find out the level of risk for fires in the area they are in. It also suggests actions to prevent fire outbreak and how to act in case a fire should occur. While the system has recently been launched and still needs to be evaluated, it shows the clear potential of innovative approaches to reach citizens by new means of communication. In the same vein, a Chilean teen has invented an earthquake detector that sends a message via the micro-blog system Twitter when it records seismic activity. The system goes under the name @AlarmaSismos and a message is sent 5 to 30 seconds before a possible quake occurs (depending on the epicentre) to its currently 330 317 followers (29.10.2012) on Twitter[98]. @AlarmaSismos is a crude instrument and, similar to BRANDRISK Ute, too recent for

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94 http://www.preventionweb.net.

95 Zschocke, T., J. Carlos de Leon, and J. Beniest, 2010. Enriching the Description of Learning Resources on Disaster Risk Reduction in the Agricultural Domain: An Ontological Approach. MTSR 2010: 320-330.

96 http://climate-adapt.eea.europa.eu.

97 For more information see: http://www.dinsakerhet.se/brand/Eldning/Appen-BRANDRISK-Ute/.

98 For more information see: https://twitter.com/AlarmaSismos and http://thenextweb.com/la/2011/07/18/meet-the-chilean-teen-who-warns-of-earthquakes-on-twitter/.

proper evaluation, however it showcases the large potential for innovative and unconventional methods that are available for DRM.

Finally, the Internet can be beneficial for making decisions and plans available online. The Portuguese National Emergency Planning System (SIPE) platform, for example, contains all approved emergency plans ordered by provinces and risk type. All these practices raise the awareness of the general public and make them more interested in the hazards and risks of their region. Nearly every disaster related project is accompanied by a website and sometimes these Internet portals play key roles.

To conclude, GPs in information sharing and awareness raising share three key features:

(1) Information campaigns and awareness raising must be tailored to the audience. Children learn in different ways from adolescents, and people aged in their twenties have different habits than retired people. Authorities and campaigners need to find appropriate measures to tailor all hazards and communication channels to optimise information dissemination to the audience, including vulnerable groups.

(2) Stakeholder participation in information and awareness raising campaigns appears to be beneficial, particularly in the planning stage. Stakeholder participation could enhance information and awareness raising campaigns by creating ownership and better solutions for targeting segments of society that differ in age, income, education, religion, and vulnerability.

(3) Internet based web portals, webpages and social media should be used to reach a maximum amount of people. It is clear that many countries have built up comprehensive and well-functioning portals and pages for campaigns to support disaster risk prevention in multiple or single hazards. This could and should be transferred to countries without such instruments.

4.3.2 Capacity building for professionals and educators

States, regional and local authorities are responsible for implementing anticipatory and prevention measures. To fulfil this responsibility, authorities need to have adequate awareness and know-how about different hazards, their occurrence in time and space, and their inter-linkages. It also requires an understanding of how resilience differs across people with different age, education and income, and how climate change enhances risks[99]. Finally, authorities need the capacity to interpret data and formulate adequate responses within often short and stressful timeframes. When these capacities are lacking there needs to be training and capacity building activities available, to ensure that professionals entrusted with implementing DRM have the necessary knowledge levels.

Workshops, conferences, courses and seminars targeting professionals can be found all over Europe, on horizontal measures as well as on specific hazards.

Capacity building through seminars, conferences, lectures, etc., is often a central task for the National Platforms. In 2010 in Sweden, for example, the Swedish National Platform for DRM (HM55) in co-operation with a number of county administrative boards conducted a series of seminars on the prevention and management of flood risk. These seminars were conducted at four locations from north to south in the country and information from the authorities was co-ordinated in

[99] Prieur, M.,2011. Ethical Principles on Disaster Risk Reduction and People's Resilience. European and Mediterranean Major Hazards Agreement (EUR-OPA) Access via: http://www.coe.int/t/dq4/majorhazards/ressources/pub/Ethique_Text_EUR-OPA_EN.pdf.

blocks mixed with good examples from different municipalities. The series attracted over 200 participants from municipalities, county administrative boards, companies and agencies. The series was documented in a book and sent to all participants and also used in information work from the various authorities. Moreover, entire centres exist to support the education of single and multi-hazards in most European countries. In Poland (HM39) for example, the Centre for Hydrological and Meteorological Education at IMGW was created in 2006. Its main task is to provide workshops and lectures for administration and other entities in hydrology, meteorology, water management issues, database and GIS solutions (for example flood hazard and flood risk maps), crisis management and public participation[100].

Capacity building can also be practically applied with hands-on exercises. The British Environment Agency (FL96), for example, provides national training courses that cover the different roles undertaken by its employees during a flood event. Employees are introduced to flood forecasting and warning, and flood defence, as well as national duty officer training, or flood warning duty officer training. Another programme in Spain (FF35) with more than 10 years of history offers courses on incident command, forest fire prevention, suppression safety and investigation of accidents, and forest fire behaviour. In addition there are courses on forest fire cause investigations and basic suppression tactics.

Moreover, the Danish Emergency Management Agency (DEMA) (IR7) has a GP in place that combines practical and theoretical capacity building for professionals and educators. They provide courses and training for leaders and employees in the national and local fire and rescue services. Furthermore, the 'DEMA Emergency Services College' in Tinglev, provides operational and tactical training courses for present and future leaders of the Danish fire and rescue authorities, as well as the staff of the police and medical sector. All present and future fire and rescue leaders in Denmark pass through the 'Emergency Services College' and receive education in risk. Moreover, the agency provides courses for people who intend to become leaders of rescue divisions, which implies that courses are specialised for particular needs. These trainings also prepare personnel for international emergency operations. All of the courses include consideration of the international, national and local levels and depending on need these are more or less pronounced. Additionally, the courses are not only developed and performed by the 'Emergency Management Agency', but emerge in a wide network with different partners, e.g. local police departments. One example of this co-operation is the authorisation of students from fire and rescue services as well as the local police and the medical sector to act as 'Response Commanders' in day-to-day emergencies. Furthermore, the college itself is a good example of dealing with capacity building of professionals. It initiates an ongoing learning process within the organisation, because people are reflecting about the existing methods and have to restructure and update the existing course on offer. As a result, the DEMA is a GP that combines several positive aspects mentioned before.

To conclude, GPs in capacity building for professionals share two main features:

(1) Capacity building for professionals could be both theoretical in the forms of seminars, course, lectures, and reading materials, and practical, where personnel are exposed to real life situations and role-play to learn how to interpret situations that could happen every day.

(2) Capacity building for professionals benefits from a participative element. When stakeholders who need to co-operate in real life situations are brought together, they are able to learn from each

[100] www.imgw.pl.

other. It can also provide important feed-back to trainers to better create and formulate future learning materials for capacity building.

4.4 Disaster loss data collection

As discussed throughout the 'planning' section, a first key step in DRM is the assessment and characterisation of key risk factors, namely the hazard, exposure and vulnerability. To understand and manage risks appropriately requires observing and recording hazards and studying exposure and vulnerability. Therefore, disaster loss databases with validated data and inventories form an essential basis upon which to build upon and implement efficient and effective DRM policies and programmes.[101]

Due to the 'public good' nature of most disaster-related information[102], governments play a fundamental role in providing high quality and context-specific risk information, such as the geographical distribution of people, assets, hazards, disaster impacts, etc. to support DRM[103]. Solid baseline information and robust time series information are absolutely critical for long-term risk monitoring and assessments. This entails the regular updating of information due to the dynamic nature of disaster risk, especially in light of a changing climate and associated uncertainties. However, country and context specific disaster impact and loss data, including baseline data, from past events, is often incomplete or of low quality. This is primarily due to a lack of capacity and resources, as well as the fact that data records only date back several decades and thus do not appropriately capture sufficient reference points for certain extreme events, such as 100-year events[104]. Even in countries with reasonably good information available on direct impacts, data on social and environmental losses is limited[105]. This includes for example, data on health effects, ecosystem changes, national savings and unemployment.

On an international level, disaster impact and loss databases do exist, such as the International Emergency Disaster Database (EM-DAT) database[106] of the Centre for the Epidemiology of Disasters (CRED) in Belgium, or ones maintained by private companies, such as Munich Re's NatCatService[107] or Swiss Re's Sigma CatNET[108]. EM-DAT has over 18 000 entries on disasters worldwide from the year 1900 to the present. Data is recorded on a country-level and thus lacks information on small scale disasters. One of EM-DAT's core goals is to rationalise decision-making for disaster preparedness, as well as providing an objective base for vulnerability assessment and priority setting. The NatCatService offers the most comprehensive global coverage of disaster losses with more than 30 000 entries from the 1980s to present. The data can be used for risk and trend analyses and comprises annual statistics, informative maps, focus analyses, etc. However, the focus is primarily on insured losses and therefore the Munich Re database has limited coverage for areas with lower insurance coverage. CatNET is Swiss Re's online natural hazard information and mapping portal provided to its clients. CatNET functions and data aim to facilitate risk

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101 http://www.eea.europa.eu/highlights/natural-hazards-and-technological-accidents.

102 Benson, C. and E. Clay, 2004: Understanding the Economic and Financial Impact of Natural Disasters. International Bank for Reconstruction and Development, Disaster Risk Management Series 4, World Bank, Washington, DC, 119 pp.

103 McBean, G.A. 2008 'Communicating to Policy Makers Climate Science with its Inherent Uncertainties' in Kyoto: Ten years and still counting ed V. Grovers (Science Publishers, Enfield, New Hampshire, USA) 621-643.

104 La RED study.

105 Benson, C. and E. Clay, 2004: Understanding the Economic and Financial Impact of Natural Disasters. International Bank for Reconstruction and Development, Disaster Risk Management Series 4, World Bank, Washington, DC, 119 pp.

105 McBean, G.A. 2008 'Communicating to Policy Makers Climate Science with its Inherent Uncertainties' in Kyoto: Ten years and still counting ed V. Grovers (Science Publishers, Enfield, New Hampshire, USA) 621-643.

106 www.cred.be.

107 http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx.

108 www.swissre.com.

assessment for any location worldwide, with the ability to generate local, regional and cross-regional risk profiles. According to Swiss Re's own description, the web-based service is very powerful as it can offer risk checks which not even DRM professionals are familiar with, including maps, satellite images and data illustrating risk exposure, country-specific insurance conditions, claims experience and loss dimensions[109].

On a regional level, the DESINVENTAR[110] database provided by a network of scientists in Latin America (Red de Estudios Sociales en Prevención de Desastres en América Latina – LA RED), includes small-, medium-, and large scale disasters with one of its major goals being to facilitate dialogue for DRM between all stakeholders, institutions, sectors and levels of government.

In Europe, four regional, sector-specific databases stand out. The Major Accident Reporting System (eMARS)[111] developed and managed by the Major Accident Hazards Bureau (MAHB) acts as the official reporting software for submitting accident reports to the European Commission according to the Seveso II Directive. The European Forest Fire Information System (EFFIS)[112] established by the Joint Research Centre (JRC) and the Directorate General for Environment (DG Environment) of the European Commission supports the agencies in charge of protecting forests against fires in the EU and neighbouring countries. (GDACS)[113] is a co-operation framework between the European Commission, the United Nations and disaster managers worldwide to improve hazard alerts, information exchange and co-ordination in the first phase after major sudden-onset disasters. The system provides real-time access to all relevant existing online disaster information systems worldwide and related co-ordination tools. The European Flood Awareness System (EFAS)[114] run by the JRC provides probabilistic flood alert information incorporating multiple weather forecasts, real-time weather observations from more than 5000 stations across Europe and real time hydrological stations from about 500 stations to allow for alerts being issued more than 48 hours in advance to National Authorities.

The scope of eMARS is to facilitate the exchange of information on accidents and near misses that occurred in Seveso establishments and to promote lessons learned among the EU MS and other Organisation for Economic Co-operation and Development (OECD) countries as well as the general public. eMARS contains events on chemical accidents and near misses reported to the MAHB by the competent National Authorities under the current and previous Seveso Directives since 1982. Reporting an event into eMARS is compulsory for EU MS when a Seveso establishment is involved and the event satisfies one or more of the six criteria set out in the Seveso Directive. The reporting is done on a voluntary basis by those OECD countries who are non-EU Members. The public can freely access eMARS to search for accident reports and extract specific lessons learned.

The EFFIS provides a comprehensive overview of forest fires in Europe, providing EU level assessments from pre-fire to post-fire phases. Therefore, data and analyses in EFFIS support fire prevention, preparedness, fire fighting and post-fire assessments and planning processes.

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109 OECD, 2012. Policy options for disaster risk financing and transfer, quantification of disaster losses and exposures: an OECD perspective. (http://www.gfdrr.org/gfdrr/sites/gfdrr.org/files/Chapter_17-OECD_Options_for_Disaster_Risk_Financing_and_Transfer_and_Issues_in_Quantification_of_Disaster_Losses_and_Exposure.pdf).

110 www.desinventar.net.

111 http://mahb.jrc.it/index.php?id=39.

112 http://effis.jrc.ec.europa.eu/.

113 www.gdacs.org.

114 http://floods.jrc.ec.europa.eu/efas-flood-forecasts.

Additionally, the private sector has also recently launched a regional disaster loss database, the Pan-European Risk Insurance Linked Services (PERILS)[115], operational since 2010 and supported by a group of major insurance, reinsurance and intermediary companies, namely Allianz SE, AXA, Assicurazioni Generali, Groupama, Guy Carpenter, Munich Re, Partner Re, Swiss Re and Zurich Financial Services. PERILS offers two main products, the PERILS industry exposure and loss database and the PERILS industry loss index service. All the data and analysis covered by PERILS are related to property insured losses in Europe. Currently, the geographical scope of the datasets is limited to Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom, and the database only covers property windstorm losses (plus flood losses for the United Kingdom). However, it is the intention to widen the scope to all of Europe and to include other insurance-related hazard types, such as earthquakes in the future.

On a national scale, the UK Major Hazard Incident Data Service (MHIDAS)[116] is a publicly available fee-based international database reporting on hazardous materials disasters. The service is maintained by Ricardo-AEA (former AEA Technology plc) on behalf of the UK Health and Safety Executive. The database focuses on hazardous materials accidents in the UK and the US over the past 20 years and significant events prior to that.

The following sections further analyse these existing databases on international, regional and national levels that represent GPs in disaster loss data collection. The chapter ends with a brief analysis of the common characteristics of the disaster loss data collection practices.

4.4.1 The importance of scales for establishing meaningful disaster loss databases

As mentioned before, disaster loss databases exist across various hazard types, sectors and levels of government. In order to contribute meaningfully to the DRM process, however, the right scale has to be determined when setting up a disaster loss database.

From national to local level

For national risk assessments, determining elements at risk represents important basic empirical input data. These could ideally stem from national asset inventories, national population censuses and other similar national statistical information over the longest period of time possible. In practice, however, collecting an inventory on assets and their associated values often proves challenging and expensive. Additionally, DRM requires the identification of social processes that contribute to vulnerability, such as economic and organisational capacities, to respond to disasters, as well as evaluating the impacts following a disaster event. While considerable progress has been made in generating and utilising such information on a national level in many countries, it is still not regular practice[117]. In Europe, Italy, Croatia, Serbia and Albania have voiced plans to develop such national multi-hazard disaster loss databases[118].

Italy already has quite a comprehensive loss database covering floods and landslides from 1900 to 2004 (more than 8000 floods and 15000 landslides) called Aree Vulnerate Italian database (AVI DB). The government has recently committed additional resources for the update of this database, especially in response to the obligations imposed by the Preliminary Risk Assessment in the EU

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115 www.perils.org.

116 http://www.hse.gov.uk/index.htm.

117 Cardona, O.D., M.G. Ordaz, M.C. Marulanda, M.L. Carreno, and A.H. Barbat, 2010. Disaster risk from a macroeconomics perspective: a metric for fiscal vulnerability evaluation. Disasters, 34(4), 1064-1083.

118 UNISDR, 2012. Main elements and highlights for EFDRR to provide input to for 2013. Presentation by Paola Albrito. (http://www.unisdr.org/files/27513_26efdrr3oct2012croatiaunisdrfutureh.pdf).

Floods Directive 2007. Good national databases also exist for earthquakes and forest fires. In addition, comprehensive risk assessments are carried out on a regular basis at different levels of the system under the responsibility of municipalities, provinces and regions, with a strong support given by the national government.

Recently, CIMA has worked together with UNISDR and the Italian Civil Protection Department to make the AVI DB compatible (interoperable) with DesInventar for past and future events and to integrate also other perils in a multi-risk framework. At this point in time, CIMA is in the process of consultation with all relevant stakeholders, including private and public institutions that produce complementary loss information, to harmonise all existing national loss databases into one multi-hazard database. This harmonisation effort is carried out through the National Platform via the establishment of a specific Working Group. Technically, the old AVI DB is already on the DesInventar Platform, but it is not public. The institutional framework definition for future multi-hazard data collection corresponding to the database efforts is expected to still take a while.

Croatia already has thematic databases in place, including linkages with systems measuring various parameters (radiological, weather, seismologic, air quality), as well as operating procedures for providing data to relevant services. The process of linking separate databases into a single database and their transfer to GIS, however, is time-consuming and requires additional financial resources and appropriate ITC equipment and well-trained personnel.[119] For this reason, the Croatian national disaster management authority has asked UNISDR for DesInventar instalment and introduction in Croatia, with corresponding financial and expert support. The DesInventar Methodology has been chosen by the United Nations for the development of historical loss databases on past disaster events in disaster-prone countries and subsequently UNISDR is committed to extending its support to building the corresponding institutional framework within governments that will ensure the maintenance and regular updating of the database. The database development is still in the very early stages and no tangible outcome has been published yet.

Similarly, UNISDR has proposed to the Sector for Emergency Management of the Ministry of Interior in Serbia to provide financial and expert support for the establishment of the national multi-hazard loss database through provision of the DesInventar software and methodology. Serbia still has to respond to (i.e. accept) the offered assistance and commence the development phase.

For Albania, a disaster loss database is currently not existent, but UNISDR has committed to support such development based on the DesInventar Methodology from 2012 onwards in collaboration with the Ministry of the Interior. CIMA will be the technical implementer of the project, which will be developed in two parallel lines: (a) building up the past events inventory; and (b) providing an institutional and technological framework for future maintenance of the database.

The reliability of disaster economic loss data is particularly problematic at the local level[120]. Most spatial coverage and resolution of the global databases represent entire countries, not sub-units within it such as states, provinces, counties, or even cities. Analyses on different scales of observation and levels of spatial resolution can provide the relevant element for decision-makers to gain new insights into risk, including the importance of local context, recurrences of losses caused by low-intensity events within the same territory and thus processes of risk accumulation.

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[119] Perini, J. 2012. National progress report on the implementation of the Hyogo Framework for Action (2011-2013) - Interim (Croatia) (http://www.preventionweb.net/files/29329_hrv_NationalHFAprogress_2011-13.pdf).

[120] IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

From large to small and medium scale disaster

Often thresholds for inclusion in the global loss databases, where only large economically significant disasters are included, bias the data toward single events with large losses, rather than multiple, small-scale events with fewer individual losses for each event[121]. However, as has been mentioned above, such low-intensity events, when repeated frequently, can lead to large socio-economic losses particularly at a local context. For example, many of the so-called 'disasters' in the EM-DAT and especially the DesInventar databases are not triggered by statistically extreme hazard events, but they rather exhibit extreme losses due to severe interruptions in the functioning of local social and economic systems. Since its establishment, the DesInventar database has registered tens of thousands of small- and medium-scale disasters across Latin America and the Caribbean. Munich Re's NatCatService also includes a disaster classification covering small loss events with property damage on a small scale and less than ten fatalities, and moderate loss events with some property and structural damage and up to 20 fatalities. [122]

Co-operation across scales

Co-operation of all actors involved in the conceptual and methodological development, maintenance and use of disaster loss databases is crucial. This includes for example, universities and research centres, NGOs, government agencies related to disaster response and risk management and other entities that facilitate the process. Further, it also includes close co-operation with the private sector, in particular with reinsurers who operate some of the most developed databases in the world. While many other fields in risk management can be carried out with few actors and institutions, one of the good practice characteristics for well-functioning disaster loss databases is that their conceptual and methodological framework has been developed and is being implemented by a wide range and a large number of actors. While such a multi-stakeholder process renders the process costly, it is absolutely essential for the gathering of reliable data and information in the long term.

DesInventar for example, has been applying such co-operation across all scales of government, sectors and hazards since its outset in 1994[123]. The programme involved researchers, academia, and institutional actors working together for the development of the DesInventar methodology and software tool that makes visible disasters from a local scale (such as a town) to a national scale. This contributes to one of the projects core goals of facilitating dialogue for DRM between actors, institutions, sectors and levels of government. Similarly, EFFIS requires the co-operation of various different groups of actors at different scales of government in order to function effectively. The development of the European Drought Observatory (EDO)[124] by the JRC for which a prototype will be ready by the end of 2012 for drought monitoring, forecasting and assessment also requires close collaboration across government scales and amongst Member States to achieve the intended goals of closing the gaps on past events data and their impacts at European level, as well as gaps in data on water consumption and water scarcity.

On a national level, in Italy, the National Civil Protection Department has the responsibility to provide the entire system with guidelines and Directives concerning how risk assessments have to be conducted, made available and circulated from one level to the others. These measures are provided through National Forecasting and Prevention Programmes. The Regional Administrations are then responsible for translating the National Guidelines into Regional Programmes in which roles and responsibilities of lower-level administrations are defined together with information

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121 GRIP, 2010. Establishing and Institutionalising Disaster Loss Databases in Latin America: Guidelines and Lessons.

122 Catastrophe classes according to Munich Re.

123 http://www.gripweb.org/gripweb/sites/default/files/documents_publications/latin_america_2012_04_25.pdf.

124 edo.jrc.ec.europa.eu.

exchange procedures. Provincial and municipal risk assessments are strongly related, since risks very often fall across the boundaries of two or more municipalities. In these cases, the co-ordination role played by the Provinces, or by inter-municipal co-operation bodies, is vital to success.

4.4.2 *Inconsistencies in data reporting and lack of standardisation*

Comparisons of international and national disaster loss databases have shown that what gets counted and documented as disaster losses (e.g. insured versus uninsured losses; direct versus indirect losses, loss-only data versus a combination of loss and gain estimates, etc.) varies between databases due to inconsistencies in the definition of key parameters and estimation methodologies[125]. Currently, many different tools and formats to systemise information on disasters are in use and vast volumes of information are still pending compilation and systemisation. Thus, depending on the ultimate purpose of the given database, spatial and conceptual gaps exist. This underlines the need to standardise parameter definitions and estimation methodologies if disaster loss data is to be made comparable across scales[126]. However, there is still a lack of international consensus regarding GPs for collecting these data in a more standardised way, due to the huge variability in definitions of terminology, methodologies, tools and even sourcing of information.

Such lack of standardisation is exemplified by the fact that two of the world's most comprehensive databases, EM-DAT and NatCatSERVICE, currently apply different thresholds for events to be entered and they use different information sources as inputs and methodologies for data collection and validation. Whereas Munich Re NatCatSERVICE uses primarily financial and insurance related sources, EM-DAT mainly relies on UN and humanitarian sources. Both databases apply their own strict data collection methodologies and quality data validation procedures. Nevertheless, they have made progress in ensuring to use a standardised peril classification and definition which allows for comparing events.[127]

Differences in definitions and estimation methods not only render comparisons across scales impossible, they also lead to communication gaps between professional groups due to different language styles and jargon applied. Thus, there is a need to continue standardisation efforts for the sake of improved comparability and increased transparency as well as reliability of data sets. EM-DAT and NatCatSERVICE are, for example, currently working on standards for geo-coding.[128] Experts also recommend establishing universally shared basic operational definitions of key terms such as risk, vulnerability, and adaptation across different sectors as a basis for the effective sharing of knowledge and information. The UNISDR's *Terminology on Disaster Risk Reduction*[129] published in 2009 and the International Organisation for Standardisation's (ISO) *Guide 73:2009 on Risk Management Vocabulary*[130] currently offer the most comprehensive and widely accepted definitions of the most common terms and jargon used in DRM. These include for example: acceptable risk, capacity, consequence, coping capacity, critical facilities, disaster risk, exposure, event, frequency, hazard, level of risk, residual risk, resilience, risk, risk acceptance, risk aggregation, risk assessment, risk financing, risk matrix, risk owner, risk profile, risk register, risk sharing, risk transfer, structural and non-structural measures, vulnerability. For the specific context of fostering greater comparability of data and for ensuring that risk information is interpreted

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125 IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

126 Guha-Sapir and Below, 2002; ECLAC, 2003; Tschoegl et al., 2006.

127 http://forum.eionet.europa.eu/eionet-air-climate/library/public/workshops/disaster_19-20_2010.

128 http://forum.eionet.europa.eu/eionet-air-climate/library/public/workshops/disaster_19-20_2010.

129 http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf.

130 ISO. ISO Guide 73:2009 Risk Management – Vocabulary.

correctly by the target audience, certain terms and concepts need particular attention. The following terms would benefit harmonisation as this could significantly improve the understanding and comparability of disaster databases:

- definition of a 'disaster' / 'catastrophe';
- definition of a 'loss':
  - differentiation between 'insured loss' and 'uninsured loss';
  - 'direct' versus 'indirect' losses;
  - 'economic' versus 'social' versus 'environmental' losses;
  - 'total loss' (loss-only versus loss/gain calculations).
- definition of fatalities:
  - what is a 'dead' versus a 'missing' person versus an 'injured' person;
  - what is 'total affected' people.

At the international level, the Disaster Loss Data Working Group of the Integrated Research on Disaster Risk (IRDR)[131] is studying issues related to the collection, storage and dissemination of disaster loss data. While government agencies, private companies and other organisations already collect and manage disaster loss data related to their own areas of relevance and using their own standards and procedures, the lack of collaboration tends to result in gaps, inconsistencies and biases that ultimately affect the policy decisions made based on this data. Under the IRDR umbrella, government agencies, private companies, and other organisations (such as the European Commission Joint Research Centre) therefore share part of the collected data and try to harmonise standards and procedures. The Working Group has identified need for the following five key actions:

- Development of comparable and accessible disaster loss data to support research and policy;
- Identification of existing loss database projects (from national to regional to global) for "lessons learned";
- Definition of what constitutes a 'loss' and creation of a common methodology for assessing that loss;
- Increased down-scaling of loss data to sub-national scales for policy-makers;
- Education of users regarding data biases and issues associated with social loss data.

To work toward these actions, the Working Group intends to establish an overall framework for disaster loss data for all providers, establish nodes and networks for databases, conduct sensitivity testing among existing databases and create mechanisms for archiving loss data[132].

4.4.3 Types of information (disaster loss database content) required for effective disaster risk management

GPs for disaster loss databases show common trends as to what types of information, or content, is required in order to be able to use the database for effective DRM. While there are certainly hazard and scale specific information requirements, several cross-cutting information needs can be identified. For example, to account for a changing climate and how it affects risk variables, time series information on climate variables, such as air and sea surface temperatures, rainfall and precipitation, wind and air circulation patterns, as well as greenhouse gas levels is essential. Seasonal climate forecasts, as well as in situ measures of soil moisture, vegetation growth, rainfall-runoff, crop yields and epidemiology all assist with preparedness and planning. To contribute to hazard zoning, databases need to offer geo-referenced inventories of hazard occurrence and impacts at local, sub-national and national levels. Further, the geospatial distribution of human

[131] http://www.irdrinternational.org/about-irdr/scientific-committee/working-group/disaster-loss-data/.
[132] http://www.irdrinternational.org/about-irdr/scientific-committee/working-group/disaster-loss-data/.

development indicators, such as poverty, livelihood sources, critical infrastructure, etc. is a prerequisite for calculating vulnerability levels. In addition, loss databases need to establish a system of risk indicators appropriate for macro factors such as economics finance, social and environmental risks, human vulnerability conditions and strength of governance[133].

The eMARS database represents an example of a system with a unique characteristic because of the inclusion of not only accidents but also near-misses (with the distinction that, while accidents have to be notified, notifying near-misses is good practice), which are particularly important for learning about how to prevent rare events. The EFFIS database has been harmonised over a long time period involving close interaction between the EC and MS. However, so far it does not sufficiently include impacts of forest fires. This can be explained due to the fact that MS reporting requirements do not include information on environmental, social and economic costs. The EC has proposed to address this issue by including a new module on assessing economic and social impacts in the revised legislation[134].

4.4.4 The use of information and communications technologies (ICT) for managing and communicating disaster loss data

As in most other fields, the use of information and communications technologies (ICTs) such as digital libraries, computer networks, satellite communications, geographic information systems (GIS), remote sensing, grid technology, etc. has become the preferred means for data and information integration for knowledge acquisition and sharing. ICT offers advantages such as interactive modes, communication across distances and universal accessibility for online data sharing and retrieval.

DesInventar has been created as a conceptual and methodological tool for the construction of databases of disaster loss, damage and effects and is supported by underlying ICT software for input to the database, as well as software for consultation of the data, with selection options for search criteria.

Similarly, on a regional scale, the EFFIS demonstrates the advantages of setting up disaster loss databases that communicate information via integrated ICT structures. EFFIS consists of a scientific and technical infrastructure at the Joint Research Centre of the European Commission (JRC) and operating a web-based platform. EFFIS is supported by a network of experts on forest fires from 22 EU countries. The online web-based system is supported and maintained via a huge EU fire database. Additional reports on forest fires in Europe are produced on an annual basis. During the main fire season (June to September), in addition to sharing information on the website, daily emails to forest services and civil protection services of the EU ensure that maps of forecasted fire danger reach the relevant national and local actors responsible for prevention measures. Email services are also used to provide quarterly fire statistics for the ongoing fire season and monthly newsletters.

Two potential limitations of relying heavily on ICT as a basis for disseminating the databases is that there is still a large part of the world where ICT infrastructure is not sufficiently developed and the fact that ICT infrastructures are often overwhelmed and collapse during a disaster event. However, these limitations may not be as relevant in a primarily European context.

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133 Wilby, R.L., Troni, J., Biot, Y., Tedd, L., Hewitson, B.C., Smith, D.G. and Sutton, R.T. 2009. A review of climate risk information for adaptation and development planning. International Journal of Climatology, 29, 1193-1215.

134 http://forum.eionet.europa.eu/eionet-air-climate/library/public/workshops/disaster_19-20_2010.

4.4.5 *Data analysis, translation into information and its use for policy-making*

In addition to harmonising data input methodologies and parameters, subsequent analysis of the data, translating data into information and its use for policy-making including decisions for the needs in prevention, preparedness, emergency planning and response is of utmost importance. Without such usage of the databases for analysis and integration into policy processes they remain research activities, not living practical tools that can facilitate DRM. This need for translating data and analysis into useful information for policy-making has been covered in the risk modelling discussion in section 4.2.3 above.

4.4.6 *Common findings from the GPs*

To conclude, GPs have demonstrated the importance of establishing disaster loss databases for informing the DRM process. The review of good practices has shown that an improvement in disaster loss information on the international and national levels is not sufficient. In particular, for translating the information into action for DRM, context-specific variables need to be added on a more local scale. This requires good co-operation of all actors involved across agencies, hazards, sectors and levels of government.

Further, more attention is required to identify what type of information and content is really essential for these databases to be able to adequately inform the various stages of DRM. This involves the development of common terminologies, variables and methodologies.

ICT systems and conventional media are major tools in facilitating the necessary international exchange and dissemination of the disaster loss data and information. ICT should also foster the further integration of DRM considerations in other policy processes, such as climate change adaptation and wider sustainable development efforts.

When developing guidelines for minimum standards on procedures for disaster loss data collection several key aspects should be considered:

- close co-operation across government levels as well as with private actors, namely insurance and reinsurance companies, significantly strengthen database development;
- definition of “loss” and other important terms and proposal of a common terminology along the lines of international agreements, such as UNISDR and ISO standards (e.g. what is a dead person versus a missing person);
- definition of key variables (what type of information) to be included in disaster loss databases;
- standardised procedures for the collection and analysis of data;
  - including the definition of standards for both inter-operability and comparability of data;
  - the development of national multi-hazard disaster loss databases along the lines of the DesInventar Methodology could be encouraged as a way forward;
- links with ‘lessons learnt’ programmes that MS are expected to develop following disasters (ref. Council Conclusions);
- ability to down-scale loss information to sub-national and local levels for informing the DRM process.

4.5 Putting research into practice

The third priority for action in the HFA aims to ‘use knowledge, innovation and education to build a culture of safety and resilience at all levels’. The challenge is to improve the uptake of science in DRM. The HFA further notes: “*Disasters can be substantially reduced if people are well informed and motivated towards a culture of disaster prevention and resilience, which in turn requires the*

collection, compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities" and highlights the importance of strengthening scientific efforts, such as: 'Support the improvement of scientific and technical methods and capacities for risk assessment, monitoring and early warning, through research, partnerships, training and technical capacity- building', and the importance of cross-border co-operation in sharing research findings[135]. It is clear that science and research plays an integral part of effective DRM according to the UNISDR.

To support science based policy a massive amount of research is carried out in Europe on the technical and social dimensions of DRM. Technical knowledge helps to support EWS, assess the repercussions and mitigation options for risk. Social sciences addresses pivotal governance issues on how to ensure that policies are formulated, implemented, monitored and evaluated in appropriate manners. It is safe to say that DRM requires co-operation across technical and social disciplines to ensure the best outcomes.

The EU supports numerous DRR research projects mainly via the Commission's Framework Programmes (FP). Beyond Europe there is also a great deal of research carried out. An emerging concern however, is that much research never reaches wider audiences including policy-makers, planners and the general public. There appears to be a need for more effective interplay between technology, science, and policy in support of DRR[136]. There is also a need to improve the dialogue and understanding between scientists, policy-makers and the general public. The problem goes both ways: on the one hand, scientists are often unable to communicate their research and results in user-friendly formats and engage in dialogue "beyond the ivory tower"; on the other hand, policy-makers and planners are often not capable, able, or interested in outcomes from scientific research. The result is a sub-optimal outcome for DRM and a large risk of reinventing the wheel, repeating mistakes and wasting resources.

To improve the uptake of science in policy and planning, one can consider both top-down and bottom-up approaches. Top-down integration, where agencies on an international, national, regional and local level, accommodate research in their work, may be the most common and potentially effective method. Bottom-up approaches, however, fit well within the emerging understanding that private actors, including communities, NGOs, individuals and volunteers, play an important role in shaping and implementing DRM. Private actors should also base their action and advocacy on sound science, in order to be legitimate and relevant in DRM.

4.5.1 How to put research into practice

There have been a number of events, reports and conferences organised to better understand and answer the question of how to improve the application of research into practice. A University College London (UCL) conference on the topic highlighted inter alia two aspects: first, there needs to be a sustained dialogue between sectors and actors involved in DRM; second, knowledge is essential to build resilient communities and education and capacity building are central to 'get the message' across to children, adolescents, the general public and professionals[137]. In a similar vein, the UNISDR Scientific and Technical Committee (STC) identified three areas where action is needed: (1) mechanisms to better integrate science into policy; (2) enhanced collaboration across

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135 UNISDR, 2005. Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters.

136 UNISDR, 2009. Reducing Disaster Risks through Science: Issues and Actions, The full report of the ISDR Scientific and Technical Committee 2009".

137 UCL, 2009. Conference summary from: Disaster Risk Reduction for Natural Hazards: Putting Research into Practice. See summary here: http://www.ucl.ac.uk/drrconference/summary.html.

disciplines, also on an international level; and (3) systematic efforts to build scientific capacity[138]. It is clear that both recommendations call for efforts within the scientific community as well as between science, policy and the public.

The following sections emphasise three aspects of putting research into practice, first, how to integrate science into planning, second, how to improve cross-border scientific co-operations, and third, how to engage scientists in interdisciplinary exchange.

Integrate science into planning

Europe, mainly via FP projects, is actively working towards more practical outcomes of research. It is, for example, essential that the results of risk modelling actually be used as a tool for planning. Two ongoing research projects reflect this importance. The main objective of the FP7 project MATRIX (New Multi-Hazard and Multi-Risk Assessment Methods for Europe)[139], running from 2010 to 2013, is to develop methods and tools to tackle multiple natural hazards with a common framework for risk assessment and analysis. This should allow future analysts and policy-makers to optimise and standardise the risk modelling process, which in turn should contribute to rationalising data management for hazards and vulnerability reduction, as well as support cost-effective decisions on structural and non-structural DRM measures following a multi-hazard, multi-risk perspective. Such improved methodologies for multi-hazard, multi-risk modelling should thus allow for cascading hazards, comparing risks and better informing the planning process, as long as dissemination of results to relevant communities and end users is ensured.

Similarly, the GEM[140] was developed to bridge the gap between the increasing vulnerability to earthquakes worldwide on one hand, and the lack of reliable risk assessment tools and data in many areas on the other hand. The fact that there are no global standards that allow for the comparison of approaches to risk modelling and analysis is in juxtaposition to the fact that everyone needs to work together to better understand earthquake behaviour and consequences. GEM includes global projects, open-source information technology (ITC) development and collaborations with more than ten regions, all to develop global datasets, best practice, toolkits and models for seismic hazard modelling and risk assessment, which will be available online through the web-based OpenQuakePlatform from 2014 onwards. This model was created due to the very need of governments and companies for tools to guide their decision-making and planning processes. With this tool policy-makers worldwide will be able to calculate, visualise and investigate earthquake risk, capture new data and share findings for the exchange of lessons learned.

Moreover, several tools for planning such as EFFIS, have been presented in previous sections of this report and could well demonstrate the successful integration of science into policy making.

Science across borders

On an international level, perhaps one of the more promising approaches is the use of research centres. The HFA acknowledges their importance and notes that regional organisations and institutions should: “Establish or strengthen existing specialised regional collaborative centers, as appropriate, to undertake research, training, education and capacity building in the field of disaster risk reduction”[141].

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138 UNISDR, 2009. Reducing Disaster Risks through Science: Issues and Actions, The full report of the ISDR Scientific and Technical Committee 2009”.

139 http://matrix.gpi.kit.edu.

140 http://beta.globalquakemodel.org/gem/.

141 The Hyogo Framework for Action (HFA) p. 15.

One such practice is the set-up of the European-Mediterranean Seismological Centre (EMSC) and the Observatories and Research Facilities for EUropean Seismology (ORFEUS)[142]. EMSC is located in France in the Laboratoire de Détection et de Géophysique (LDG) of the French Atomic Energy Commission, and the centre provides real-time information on seismic activities in the Mediterranean region. EMSC co-operates closely with its sister organisation ORFEUS, which is located at the Royal Netherlands Meteorological Institute (KNMI) in the Netherlands. The members of the organisations comprise a network of seismic centres all over Europe, which enables real-time information sharing, extensive dialogue, common projects and intertwined leadership structures. The EMSC is furthermore dealing with rapid earthquake impact assessment and uses innovative approaches such as crowd sourcing and flash sourcing[143] of citizen networks to reach citizens in affected regions. It also works with citizen engagement and the perceptions of risks, through social networks. They are also heavily involved in cross-hazard and environmental monitoring networks such as Global Monitoring for Environment and Security (GMES) and Global Earth Observations System of Systems GEOSS.

Dialogue and co-operation across disciplines

Risk management takes place in the human-technological nexus. Natural sciences and technical research develops sophisticated risk assessments, building codes, sensors for abnormalities and natural flows, design mitigation and adaptation measures and ensures that infrastructure for transport, communication and electricity are resilient in times of disaster. The social sciences, such as psychology, economics and governance studies, on the other hand acknowledge that all knowledge and data that is accumulated and spread, needs to be internalised and induce behavioural change in a desired direction. Education and learning are central to transmitting knowledge and research findings to a wider audience and across disciplines.

One programme that is geared towards stimulating interdisciplinary research on DRM is the International Council for Science's (ICSU) IRDR programme that is carried out in partnership with the International Social Science Council (ISSC) and the UNISDR. The IRDR engages a global community of researchers from natural and social sciences and arranges conferences, paper publications and case studies. The IRDR is also a good example of how DRM research can learn from international co-operation and exchange knowledge and pool resources towards a common goal. The work is divided into interdisciplinary working groups with a main focus to identify gaps in science and develop innovative methods and approaches to DRR.

To summarise, putting research into practice requires three things:

1. Science needs to provide the foundation for planners and policy-makers in creating policy and risk management plans. Science should be supported to develop tools that can be easily applied in a planning context, and that are user-friendly and accessible. Planners and policy-makers should, on the other hand, be stimulated to engage and take an interest in research and science;
2. Science provides an excellent opportunity to work across borders and engage in knowledge exchange. If done properly, it may enable the allocation and spread of scarce resources and allow for specialisation;
3. Finally, scientists and researchers need to be aware of the added value of inter-disciplinary work, both within the natural and technical sciences as well as between the social and natural sciences.

[142] For more information see: http://www.orfeus-eu.org/.
[143] For more information see: http://www.annalsofgeophysics.eu/index.php/annals/article/view/5265/5495.

5 Moving towards guidelines for minimum standards in Disaster Risk Management

The following chapter starts the translation of good practices (GPs) into guidelines for minimum standards. The analysis is based on chapter 4 and is separated into four general guidelines and a number of sub-guidelines. The themes are: Governance, Planning, Information and Capacity Building, Disaster Loss Data and Putting Research Into Practice. For each sub-guideline we suggest language and substantiate them with GPs identified during the study.

5.1 Guideline: Ensure an integrated governance approach to disaster prevention

Governance is perhaps the broadest and most foundational theme in disaster risk management (DRM). Good governance requires authorities, industry and civil society to work across administrative and geographical borders to foster a culture of disaster prevention. In an integrated strategy; national, regional and local stakeholders collaborate to identify, assess, plan and prevent risk. Such collaborative and inclusive governance is particularly important in regions facing cross-border disaster risks where the jurisdiction of national co-ordination agencies overlap.

5.1.1 Promote integrated multi-level governance

Integrated multi-level governance is relevant at national, regional and local levels of government. Currently agencies mandated with responsibility for disaster prevention tend to be weak in resources and relatively marginalised in terms of institutional power. It is perhaps unrealistic to expect such agencies to take centre-stage in government networks, but they can be enabled to have a more effective co-ordinating role and ultimately to develop well-organised multi-stakeholder mechanisms for governing disaster prevention activities. For this they need the appropriate institutional position as well as adequate human and financial resources.

The national process should include relevant stakeholders on a horizontal level, in particular those from governmental agencies such as health, safety, emergency planning and infrastructure and managed by a co-ordinating entity. It may enable agencies and ministries, such as energy, climate and environment that currently work in isolation, to benefit from each other's knowledge and resources[144]. Such an entity could, for example, be a National Platform co-ordinated by an agency (generally under the Prime Minister) or a non-governmental organisation (NGO). The setting up of National Platforms, as described in the Hyogo Framework for Action (HFA), has proved effective in organising stakeholders on a national level. Generally, the effectiveness of strong National Platforms is based on several core principles that can apply to disaster governance at the national level. These are: (1) recognise and address the underlying causes of vulnerability in order to promote genuinely resilient communities; (2) draw on robust evidence and technical expertise in formulating plans and policies; (3) generate sufficient trust and mutual respect to engage a range of

[144] IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

stakeholders in decision-making; and (4) be accountable, transparent and reflexive (monitor the effectiveness of programmes)[145].

National Platforms embody the principles of dialogue and collaboration in DRM, however collaborative approaches could be implemented in less formal arrangements. The inclusion of stakeholders and the creation of partnerships between public and private interests are increasingly understood as an effective instrument to formulate and implement DRM policies, in particular due to the capacity of business and community based organisations to mobilise support on a local level. The Intergovernmental Panel on Climate Change (IPCC) highlights the importance of such partnerships for inter alia, increased risk sharing and the uptake of insurance-related instruments, the engagement of private sector organisations and to address the underlying drivers of vulnerability[146]. The partnership approach should be promoted on an international level - mainly via UNISDR, on a national level - mainly via horizontal arrangements such as National Platforms and on regional and local levels - mainly by involving community based organisations, businesses and academia. Finally, vertical partnerships between national and local governments could yield improved cost-efficiency and greater effectiveness, particularly in regards to the responsibility of local government and communities to implement DRM.[147]

Ensure adequate financial and human resources

Actors need adequate financial and human resources to carry out their mandate and are often a key success factor in policy implementation[148] [149]. The HFA Europe Report[150] states "…the lack of financial resources…particularly at local levels, is the major barrier to progress." There is often a mismatch between the demand for disaster risk reduction (DRR) services and operations on the one hand, and the availability of resources on the other.

One approach to address the mismatch between demand and supply of resources is through the use of public-private partnerships. Up until now, international DRM financing, for example, is heavily dependent on resources from bilateral and multilateral co-operation[151]. Therefore, in 2009, the World Bank and UNISDR, in partnership with the Regional Co-operation Council of South-Eastern Europe (RCC SEE), established the South East and Caucasus Catastrophe Risk Insurance Facility

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145 The United Nations Office for Disaster Risk Management (UNISDR) has published a good practice booklet on national platforms globally, which could offer support to establish new platforms and improve existing ones, see for example: UNISDR, Council of Europe and DKKV (2008) Disaster risk reduction in Europe: Overview of European national platforms, Hyogo Framework for Action focal points and regional organizations/institutions, Updated version of Report on implementation of the Hyogo Framework for Action: Europe ISDR/GP/2007/Inf.6, 20 May 2008; UNISDR, ILO and UNDP (2010) Local Governments and Disaster Risk Reduction: Good Practices and Lessons Learned, A contribution to the "Making Cities Resilient" Campaign; UNISDR (2012) Overview of National Platforms for Disaster Risk Reduction in Europe: Fact Sheets of European National Platforms, April 2012.

146 The UNISDR has published a GP booklet on National Platforms globally, that could offer support to establish new platforms and improve existing ones, see for example: UNISDR, Council of Europe and DKKV (2008) Disaster risk reduction in Europe: Overview of European national platforms, Hyogo Framework for Action focal points and regional organizations/institutions, Updated version of Report on implementation of the Hyogo Framework for Action: Europe ISDR/GP/2007/Inf.6, 20 May 2008; UNISDR, ILO and UNDP (2010) Local Governments and Disaster Risk Reduction: Good Practices and Lessons Learned, A contribution to the "Making Cities Resilient" Campaign; UNISDR (2012) Overview of National Platforms for Disaster Risk Reduction in Europe: Fact Sheets of European National Platforms, April 2012.

147 See: Dodman, D., J. Hardoy, and D. Satterthwaite, 2008. Urban Development and Intensive and Extensive Risk. Contribution to the Global Assessment Report on Disaster Risk Reduction (2009), International Institute for Environment and Development, London, UK, for casestudies carried out in developing countries.

148 UNISDR, 2011. Hyogo Framework for Action 2005 – 2015: Building resilience of nations and communities to disasters. Mid-term review 2010-2011. (http://www.unisdr.org/files/18197_midterm.pdf).

149 UNISDR, 2011. Implementing the Hyogo Framework for Action in Europe: Advances and Challenges. Report for the period 2009-2011. (http://www.preventionweb.net/files/19690_hfareportwebfinal.pdf).

150 UNISDR, 2011. Implementing the Hyogo Framework for Action in Europe: Advances and Challenges. Report for the period 2009-2011. (http://www.preventionweb.net/files/19690_hfareportwebfinal.pdf).

151 Jackson, D.,2011. Effective Financial Mechanisms at the national and local level for Disaster Risk Reduction. Paper written for the mid-term review of the UNISDR Hyogo Framework for Action. Available at: http://www.unisdr.org/files/18197_202jackson.financialmechanismstosup.pdf.

(SEEC CRIF). It allows relatively small countries to diversify of risk on a regional level, thereby lowering their cost of risk capital. The German Association for International Co-operation (GIZ/GTZ) has taken similar action regarding early warnings systems (EWS)[152]. The partnership approach is furthermore useful for engaging volunteers, community organisations and businesses. It is in this sense more than a method to spread costs across different actors.

Another viewpoint is that mainstreaming of DRM into other policies may increase the amount of human and financial resources an agency can spend on it[153]. Costs for prevention are often already embedded into sectoral policies, as in the case with infrastructure, for example. Nevertheless, the proposition is that if DRM becomes normal practice, fully institutionalised within an agency's relief and development agenda, it will increase the financial resources allocated for it. A higher budget normally has by far more potential to promote sustainable long-term risk reduction[154]. Other benefits of integrating DRM into other policies and sectors are discussed later in this chapter.

Clarify division of tasks and responsibilities at appropriate levels

Besides adequate resources, multi-level governance requires a clear division of tasks to ensure that measures are carried out on an appropriate, often local, level. Local level action is central in good DRM due to the proximity to citizens, knowledge of local areas and their mandate to carry out basic environmental management and regulatory governance functions that are important to effective DRM.[155, 156]

Decentralisation of tasks and authority is an often cited method to allocate resources in an efficient and coherent way. The Mid-Term Review of the HFA recommends the development of a plan of action that includes a division of labour amongst various partners. In the past, it could already be observed that the definition of roles and tasks seems to have been helpful in supporting the development of similar frameworks at regional and national levels. The International Federation of Red Cross and Red Crescent Societies (IFRC)[157] as well as the Swedish National Platform for Disaster Risk Reduction[158] identified, in their contributions to the Mid-Term Review, a need for stronger co-ordination at the international level and clearer definition of roles and responsibilities for all stakeholders involved in DRR. In Iceland for example, the threat of volcanic activity is always present. Even though the island lacks an army, they have a well-integrated system of response where tasks are divided between civil defence, the Icelandic Red Cross, police, fire-fighters, independent search-and-rescue associations and special auxiliaries including the scouts. Both the Red Cross and the search-and-rescue associations are entirely made up of volunteers. Additionally, disaster relief centres have been designated with trained leaders throughout the island, even in sparsely populated areas. These leaders often consists of teachers, which builds upon the heart of effective disaster education in Iceland[159], Moreover, that local or decentralised DRM is key in later stages of the disaster management cycle was shown after the Marmara earthquakes in Turkey

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152 GTZ report, available at http://www2.gtz.de/dokumente/bib/02-5001.pdf.

153 Jackson, D., 2011. Effective Financial Mechanisms at the national and local level for Disaster Risk Reduction. Paper written for the mid-term review of the UNISDR Hyogo Framework for Action. Available at: http://www.unisdr.org/files/18197_202jackson.financialmechanismstosup.pdf.

154 Ibid.

155 Jackson, D., 2011. Effective Financial Mechanisms at the national and local level for Disaster Risk Reduction. Paper written for the mid-term review of the UNISDR Hyogo Framework for Action. Available at: http://www.unisdr.org/files/18197_202jackson.financialmechanismstosup.pdf.

156 Plan International and World Vision International (2009) *Children on the Frontline: Children and Young People in Disaster Risk Reduction.*

157 Hyogo Framework for Action Red Cross Red Crescent Mid-Term Review October 2010.

158 Swedish Civil Contingencies Agency, 2009. Risk and Vulnerability Reduction Department Natural Hazards and Critical Infrastructure Section.

159 IFRDC & RDC, 2002. World Disaster Report 2002. International Federation of Red Cross and Red Crescent Societies. Available at: http://www.ifrc.org/Global/Publications/disasters/WDR/32600-WDR2002.pdf.

where at least 50 000 people were found alive under collapsed buildings, 98% of whom were rescued by neighbours and other locals[160]. Finally, in Italy, volcanic hazards and earthquakes are managed both at the central level and the periphery of the system. Such synergy is possible thanks to a network of fully operational decisional-support offices (Centri Funzionali), through which experts all over the country exchange data. The same system of information and data collection exists also for flooding and forest fires. Moreover, a high number of volunteers are spread throughout the country that can be 'activated' in case of emergency. The amount of people can vary between 1 600 in 'peace periods' and 1.5 million in very large emergencies. Another area of excellence is the clear chain of command in the Italian system and the high portion of the Civil Protection budget allocated toward research and development[161].

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for action are proposed:

- **At national level, develop a horizontal mechanism to co-ordinate disaster prevention across a range of agencies and stakeholders, such as a platform for DRR, that may include sectoral agencies that do not have primary responsibility for prevention, such as those responsible for housing, infrastructure, utilities, health care, economic and land use planning, etc., as well as those primarily engaged in emergency response and recovery**. Such a mechanism should also include non-governmental (voluntary organisations, academia) and private stakeholders, in order to maximise the engagement of key actors in the governance process. The National Platforms for DRM can provide an effective mechanism at a national level;
- **Distribute responsibilities and tasks to the most appropriate levels (which is often local).** Authorities and agencies, often under one co-ordinating authority (usually the Prime Minister), should be delegated responsibility in terms of competencies, hazard/sector concerned and institutional arrangements for co-operation. In many cases, focus should be on the local level since this level generally has the best knowledge and understanding of local conditions;
- **Allocate appropriate human and financial resources for authorities to carry out DRM tasks, as well as involve other sectors of society through innovative partnerships such as public-private partnerships, links with voluntary organisations and research academia.**

Supporting practices:

- Swedish National Platform for Disaster Risk Reduction (HM59)
  For more information see: UNISDR (2012) Overview of National Platforms in Europe;
- The German Committee for Disaster Reduction (DKKV) (HM17)
  For more information see: UNISDR (2012) Overview of National Platforms in Europe;
- UK business resilience
  For more information see: http://www.london.gov.uk/priorities/london-prepared/preparing-your-business;
- Italian Red Cross system
  For more information see: http://www.cri.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/1;
- Icelandic Red Cross system
  For more information see: http://www.raudikrossinn.is/.

On a regional and local level, the principles for setting up an effective institutional arrangement are equally important as those on a national level. The configuration of the stakeholders may be different than on a national level, since effective implementation of action requires trust and mutual respect among the authorities responsible for the action and the target community. The organising

[160] Ibid.

[161] UNISDR, 2008.The Structure, Role and Mandate of Civil Protection in Disaster Risk Reduction for South Eastern Europe, available at: (http://www.unisdr.org/files/9346_Europe.pdf).

principle of subsidiarity may be useful where the issues are dealt with at the lowest level of authority possible and capable of effective implementation. The arrangement in the region of Emilia Romagna (HM25) is a good example of such a multi-level and multi-stakeholder approach.

Based on the abovementioned basic principles and evidence from GPs, the following guidelines for action are proposed:

- **At regional and local level, develop a horizontal mechanism to co-ordinate disaster prevention across a range of stakeholders from government, business and civil society, to foster a culture of disaster prevention at a sub-national level by collaboration and inclusiveness.** Collaborative and inclusive processes demand stakeholder involvement at an early stage of prevention planning;
- **Ensure good lines of communication across vertical and horizontal scales. Support community based approaches to strengthen the resilience of population and communities at a local level.**

Supporting practices:

- The Emilia-Romagna Regional System of Civil Protection (HM25)
  For more information see: http://www.protezionecivile.emilia-romagna.it/;
- FloodResilientCity (FL3)
  For more information see: www.floodresilientcity.eu;
- UNISDR Resilient cities campaign
  For more information see: http://www.unisdr.org/campaign/resilientcities/.

Finally, multi-level governance of DRM can focus on multiple-hazards or single hazard types. The perspective, however, should be primarily multi-hazard with the understanding that hazards are difficult to prevent and contain in isolation of each other. That multi-hazard perspective should be in addition to the hazard specific approach, addressing in further depth the specificities of the hazards and sectors.

Good examples of single hazard focus could be found in Norway (IR39) and Germany (IR22), where planning for industrial risks and transportation of dangerous goods adopt the afore-mentioned principles of involving stakeholders at an early stage in the co-ordination work. While involving stakeholders in planning related to establishments which may involve industrial risks is mandatory under the Seveso Directive, it can serve as an inspiration for other areas. Stakeholder involvement creates ownership and increases effectiveness in planning, implementation, monitoring and the evaluation of actions towards, in these cases, industrial hazards.

Based on the abovementioned basic principles and evidence from GPs, the following guidelines for action are proposed:

- **Governance for risk prevention of specific disaster types, such as industrial risks and floods, should acknowledge that hazards are not prevented in isolation and adopt a multi-hazard and cross-sectoral perspective in addition to the single risk/sector approach.**

Supporting practices:

- The Norwegian 'Directorate for Civil Protection and Emergency Planning' (DSB) (IR39)
  For more information see: http://www.dsb.no/farliggods;
- Kommission für Anlagesicherheit (KAS) - Commission on Process Safety (IR22)
  For more information see: http://www.kas-bmu.de/.

5.1.2 *Ensure implementation and improvement of existing legislation by developing mechanisms for monitoring, evaluation and feed-back*

A comprehensive legislative and institutional arrangement on a national, regional and local level is only a first step in the direction of effective DRM. Rules need to be coherent and stringent, monitoring mechanisms should be in place, enforcement should be possible and feed-back must be provided to adapt the system to external changes.

Even if it is acknowledged that monitoring, evaluation and feed-back is important to DRM, it is less manifested in GPs collected for the study. Among the better examples on a European level is found in industrial hazard prevention. Seveso Directive I, II and III are good examples of how legislation gradually enforced the importance of inspections and implementation. Whereas the Seveso I Directive only contained one small paragraph on inspection, the provision in the Seveso II Directive has been extended to an Article of its own. An attempt is made to ensure increased consistency in enforcement at the European level through greater prescriptive detail of the obligations of the Competent Authorities. In the Seveso II Directive, Competent Authorities are obliged to organise an inspection system. This system shall ensure that the operator has taken all necessary measures with regard to the prevention of major accidents and the limitation of their consequences, the safety report is correct and complete and the public has been informed. The Commission concluded a review process of the Seveso II Directive on 21 December 2010 and on 4th July 2012 a new Seveso Directive was adopted, which will repeal and replace the current Directive. MS need to ensure full implementation by 1 June 2015. With regards to inspections, the Seveso III Directive introduces stricter standards for inspections of installations, compared to Seveso II. It is expected to improve the effectiveness of implementation and enforcement of safety rules laid down in the Directive[162].

Supporting the implementation on a national level is the European Union (EU) Network for the Implementation and Enforcement of Environmental Law (IMPEL) – or network of national inspectors – which is a good example of how an international non-profit association can positively influence the environmental authorities of the EU MS, acceding candidate countries of the EU and countries of the European Economic Area and the European Free Trade Association (EFTA) to improve environmental legislation, including relevant DRM legislation. The network supports knowledge exchange and capacity building in various parts of European environmental law and policy, with a focus on implementation by inter alia holding working-shops, publishing reports and training inspectors. IMPEL promotes an approach to peer-review inspections of environmental authorities, which is highly relevant for industrial disasters and possibly other disaster areas.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for action are proposed:

- **Enhance implementation of current legislation by improving monitoring, evaluation and inspections;**
- **Promote innovative approaches to improved implementation and adaptive governance such as peer-reviews.**

Supporting practices:

- IMPEL Review Initiative project (IRI)

  See: http://impel.eu/tag/iri/.

[162] See: EC, 2012. Chemical Accidents (Seveso III) - Prevention, Preparedness and Response. Available at: http://ec.europa.eu/environment/seveso/index.htm.

5.1.3 *Improve cross-border co-ordination and co-operation*

Disasters and risks do not respect national borders. Floods, forest fires and drought, for example, regularly occur in border areas between MS and require authorities to co-operate in order to optimise disaster prevention. Cross-border co-operation should therefore be considered when making national policies, legislation, plans and actions to address risks that cross national borders.

For reasons such as national security, level of vulnerability, and economic importance of a region, a MS may opt for different levels of co-operation. The aim of effective co-operation in disaster prevention however, could develop along the following guiding principles:

1. Address common challenges;
2. Share knowledge and information;
3. Co-ordinate action and policies for risk prevention in the border areas.

Several regions in Europe, in particular in shared river basins, already have international platforms and commissions to co-ordinate management of shared resources and DRR. River basin bodies such as the International Commission for the Protection of the Rhine (ICPR) and the International Commission for the Protection of the Danube River (ICPDR) serve as good examples of management bodies that share knowledge and expertise, as well as foster a solidarity approach accrued from working under the same system. The ICPDR is also a good example of governance arrangements that promote the coherence between EU policy and disaster prevention. The ICPDR has set up the River Basin Management Plans as required under the Water Framework Directive (WFD). It has a Flood Action programme that resonates well with the Floods Directive and it works closely with the EU Strategy for the Danube Region to promote the environmental, risk and security issues in the river basin.

Regional development programmes such as INTERREG and sea-basin strategies are also good examples of how the EU can support regions in DRM as part of larger strategies for regional development. The EU Strategy for the Baltic Sea Region (EUSBSR), for example, is the first comprehensive EU strategy to target a 'macro-region'. It includes eight EU countries that make up the Baltic Sea Region (Sweden, Denmark, Estonia, Finland, Germany, Latvia, Lithuania and Poland) and two non-EU countries, Norway and Russia. While the main goals of the strategy are to save the sea, connect the region and increase prosperity, the risk management in the EUSBSR concentrates more on threats to the environment. The strategy is also involved in cross-border co-operation to mitigate the negative effects of potential disasters involving ship accidents, industrial pollution and chemical leakage.

Moreover, co-ordination and co-operation mechanisms exist in multi-level and bilateral agreements, depending on the type of the hazard and its risk related to other countries. The Spanish-Portuguese border, for example, is frequently exposed to droughts and forest fires. To combat common problems the Albufeira agreement and the Evora Protocol regulate the relationship and collaboration between the two countries.

Cross-border co-operation is not restricted to the EU. For optimal international and global risk prevention, governments should adhere to agreements, conventions, etc. established in international bodies, for example the HFA and the 'Convention on the Transboundary Effects of Industrial Accidents'[163]. International agreements and initiatives are useful to manage risks in countries bordering the EU and to share and learn from best practices across the globe.

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[163] UN and the World Bank, 2010. Natural Hazards, UnNatural Disasters: The Economics of Effective Prevention, 2010.

Based on the abovementioned basic principles and evidence from GPs, the following guidelines for action are proposed:

- **Promote new cross-border co-operation mechanisms and projects for risk prevention in regions that share common disaster risks and support and enhance existing ones.** Multi-stakeholder and multi-level co-operation regimes should be strengthened and established where needed to enhance knowledge sharing, risk assessments, monitoring and strategy planning to mitigate the risks of disasters, in particular in river basins;
- **Implement and develop existing international, EU and bilateral legislation and plans/strategies with relevance to disaster risk prevention.** The Spanish-Portuguese co-operation to prevent forest fires and droughts (DR14 and FF36) are good examples of bilateral action to address regional cross-border issues. Furthermore, national legislation and strategies should be coherent with international frameworks such as the HFA and EU policies, such as the EU Strategy for the Danube Region to ensure that synergies are reaped.

Supporting practices:

- Rhine 2020 (FL1) and (FL40)
  For more information see: http://www.iksr.org/index.php?id=30&L=3;
- The Evora Protocol (FF36)
  For more information see: http://www.ifrc.org/docs/idrl/I130EN.pdf;
- The Portuguese-Spanish Albufeira Agreement (DR14)
  For more information see: Estrela, T. (2009) Trans-boundary river basins in Spain and Portugal: the Albufeira Agreement. Presentation can be downloaded at: http://www.riob.org/IMG/pdf/04_090320_estambul_03.pdf;
- The EU Strategy for the Baltic Sea Region and the Danube Strategy
  For more information see: http://www.balticsea-region-strategy.eu/ AND http://www.danube-region.eu/.

5.1.4 *Mainstream DRM across EU sectoral and hazard-specific legislation*

Disaster prevention is both affected by and in turn affects, a number of policy fields. For example, resilience to earthquakes is closely connected to construction codes and flood protection is highly dependent on spatial planning. As previously mentioned, DRM may already be part of several sectoral policies and therefore only requires enhancement and acknowledgement by agencies, however in general, risk thinking and planning has to be integrated into other sectors. The process of such integration has recently been referred to as mainstreaming. Practically, the IPCC notes that "mainstreaming of adaptation and disaster risk management actions implies that national, sub-national, and local authorities adopt, expand, and enhance measures that factor disaster and climate risks into their normal plans, policies, strategies, programs, sectors, and organizations"[164].

Moreover, harmonisation of standards and language on DRM is important. To foster a community-wide disaster risk reduction culture there needs to be comparable data, common standards for implementation, harmonisation of terminology and integration of DRM across sectoral and hazard-specific legislation. Eurocode 8 on the seismic design of buildings (EQ18) and the Floods Directive are good examples of legislations that aim to increase the coherence of disaster prevention across sectoral and hazard-specific legislation.

[164] IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

Based on the abovementioned basic principles and evidence from GPs, the following guidelines for action are proposed:

- **Policies and legislation at EU, national and local levels should integrate disaster risk management across sectoral and hazard-specific legislation;**
- **Promote harmonisation and standardisation in appropriate fields to enable knowledge sharing and comparison between MS;**
- **Mainstream DRM into sectoral legislation and planning such as construction, spatial planning and water management, as well as into sustainable development policies such as environmental policies, social policies, health policy etc.**

Supporting practices:

- Eurocode 8 (EQ18)

For more information see:

http://eurocodes.jrc.ec.europa.eu/doc/WS_335/report/EC8_Seismic_Design_of_Buildings-Worked_examples.pdf;

- UK business resilience

For more information see: http://www.london.gov.uk/priorities/london-prepared/preparing-your-business

- Norway and Sweden's Planning and Building Acts (HM34 & HM52);

- UNISDR (2011) Implementing the Hyogo Framework for Action in Europe: advances and challenges 2009-2011. Can be downloaded at: http://www.unisdr.org/we/inform/publications/19690.

Authorities with the mandate to co-ordinate disaster prevention should be capable of managing emerging challenges. The most prominent challenge may be climate change, which is expected to exacerbate many of the weather phenomena such as floods, droughts and storms. Authorities dealing with DRM should therefore ensure that actions are adapted to more extreme climatic scenarios by mainstreaming climate adaptation into policy making at all levels. It means that climate adaptation and DRR strategies and policies are aligned and developed in close co-operation, which is commonly not the case. It also implies that authorities with responsibility for implementation of climate adaptation and DRR policy work together. There are examples where climate adaptation and DRR authorities share secretariats and buildings in order to foster close co-operation. Good practices in London (HM60) and Norway (HM37) have proven successful in incorporating climate change into DRR planning and strategy making.

Moreover, planning for climate change has impacts on how infrastructure and buildings are constructed. For adaptation to be successful, spatial plans and building codes need to be prepared for more extreme weather events. GPs in Sweden (HM52), for example, show how the risks of flooding and erosion need to be considered when planning for new developments.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for action are proposed:

- **Ensure that understanding and consideration of climate change is integrated into decision-making and actions on disaster prevention**. Preventive activities that are designed for the long-term, such as land use planning, development and location of infrastructure and water resource management, should take into account how extreme weather events, mean conditions and sea level may change in future. (see e.g. HM34, HM54);
- **Mainstream climate change into spatial planning by carrying out risk assessments and regulations for new development of buildings**. Examples (HM34) have shown how vulnerability assessments and regulations can be carried out on a municipal level if adequate support is provided from national authorities to local spatial planners;

- **Develop mechanisms to ensure integration between strategies and policies in DRR and climate change adaptation, at all scales**. It is logical for reasons of efficiency and effectiveness to ensure that there is coherence between DRR and climate adaptation efforts, but integration requires close co-ordination between agencies responsible for these two policy fields (see e.g. HM60);
- **Recognise that response to climate change must be flexible and dynamic over time**. Uncertainty over the precise impacts of climate change in specific places means that adaptation actions should retain a degree of flexibility so that they can be readily modified and updated (see e.g. HM60).

Supporting practices:

- Norway's Planning and Building Act (HM35)

For more information see: UNISDR (2011) Implementing the Hyogo Framework for Action in Europe: advances and challenges 2009-2011. Can be downloaded at: http://www.unisdr.org/we/inform/publications/19690;

- The Mayor of London's Climate Change Adaptation Strategy

For more information see: UNISDR (2011) Implementing the Hyogo Framework for Action in Europe: advances and challenges 2009-2011. Can be downloaded at: http://www.london.gov.uk/climatechange/sites/climatechange/staticdocs/Climiate_change_adaptation.pdf.

5.2 Guideline: Integrate multi-hazard risk assessment into planning for DRM at local, regional and national levels

Planning is a central theme in disaster risk management (DRM). Every community, at various levels of government, faces environmental risks and the potential for disaster increases as population density in hazardous areas grows, the built environment ages, and economies are interdependent. Planning for addressing such risks has thus gained in importance. If risks are not assessed and considered in the planning process, many decisions and policies could have profound but unrecognised impacts on disaster risks. A sound understanding of risk and risk management is thus of utmost importance for all planners to help build disaster-resilient communities. To this end, each locality should have the tools to understand the risks it faces, so that consequently in the planning process responsible, holistic policy decisions can be taken and DRM can be aligned with broader environmental, social and economic goals.

Planning thus can be defined as the process undertaken by authorities and other stakeholders to identify, understand, assess, and plan for addressing disaster risks via holistic decisions on policy options. Such planning processes are carried out at different levels of government as well as by private actors, such as for business continuity planning.

Effectively, sound planning for DRM starts with carrying out a multi-hazard risk assessment with appropriate methods and technologies. Based on the results of the risk assessment, risk management plans are set up and results are factored into other decision-making for planning processes, such as short term and long term development policies (land use planning, citing of critical infrastructure, etc.), recovery measures, capability and response planning, etc. Participative approaches involving all communities and stakeholders concerned as much as possible at all stages creates understanding and awareness, buy-in and greater coherence.

The following sections capture the various minimum components necessary for successfully integrating multi-hazard risk assessment into planning for DRM at all relevant levels of governance. More specifically, these minimum required components are: (1) apply risk assessment as a basis for guiding planning processes; (2) foster risk management planning for prevention; (3) encourage

the use of appropriate specific assessment methods and technologies, such as hazard mapping, micro-zoning, risk modelling, construction codes and early warning systems to aid the risk assessment and planning procedures; (4) ensure risk prevention proofing of investments; (5) foster integration of DRM into post-disaster recovery actions and (6) develop innovative financing mechanisms, including risk transfer and private sector involvement.

5.2.1 *Apply risk assessment as a basis for guiding planning processes*

Risk assessment across all levels of government and across all hazard types is increasingly viewed as a prerequisite, a basic starting point, for a thorough planning process and efficient DRM. Risk assessment helps guide policy making when integrated into wider planning processes, such as environmental impact assessment, land use planning at the local level or sustainable development policies at the national level. Using risk assessment as a basis for policy planning is in line with the HFA priorities for action. More effective integration of disaster risk considerations into planning and programming at all levels has been defined as one of the strategic goals countries have committed to. The usage of risk assessments for informing the planning process ensures that all programming and policies are in line with risk priorities and that they are not counter-productive and even increase risk levels.

This does not necessarily mean that one multi-hazard national risk assessment is sufficient. Rather, risks need to be analysed at all levels of government, from a single and/or multi-hazard perspective (depending on circumstances) and should be streamlined across sectors.

Risk assessment supports better planning at all levels of governance, from international to local levels. The EU Guidelines on National Risk Assessment[165] offer a good basis for harmonisation and coherence of risk assessment approaches across Europe as they develop a common approach on risk assessment methodologies and practices undertaken in the EU Member States at national level, as well as orientation on matters of terminology, the involvement of different sectors and stakeholders, and the most useful methods and concepts. The Guidelines take full account of existing EU legislation including the Directives on flood risk management, protection of European critical infrastructures, and on the control of major accident hazards (Seveso), the Water Framework Directive (drought management). Moreover, the Guidelines consider a number of Eurocodes, such as Eurocode 8 on building design standards for seismic risks, and also the Council Conclusions on prevention of forest fires within the European Union.

National risk assessments usually include risks, which are of sufficient severity to entail involvement by national governments in the response, in particular via civil protection services. At the national level, there have been major advances in national level risk assessment processes in countries such as the Netherlands, UK and Norway. The UK, for example, uses classified National Risk Assessment (HM63) to make a comprehensive, classified assessment of the most significant emergencies that the UK could face over the next five years. To make this knowledge available publicly, an unclassified version of the National Risk Assessment, the National Risk Register, is produced in parallel to assist interested communities and individuals in improving their own risk assessment and DRM activities.

Integrated and shared multi-hazard risk assessment, planning and governance involving a wide variety of actors (local authorities, relevant agencies, volunteers, private sector, etc.) can ensure effective DRM at the regional level. While the overall system should be designed to manage the

[165] EC, 2010. COMMISSION STAFF WORKING PAPER Risk Assessment and Mapping Guidelines for Disaster Management SEC(2010) 1626 final.

range of hazards affecting a region, differentiated DRM plans can been developed for the specific hazard types in order to refine the required actions for each step of the disaster management cycle based on the results of risk assessments. A good practice displaying these advantages of using risk assessment as a starting point for integrated governance and planning on a regional level is the Emilia Romagna region in Italy (HM25).

However, integration between multi-hazard risk assessment and DRM is especially relevant at the local level, where detailed land use planning takes place. For many hazard types land use planning can play a central role in enhancing community resilience through, for example, planned citing of critical infrastructure. In order to do so effectively, planning and zoning decisions must be based on detailed information via local-scale risk assessments. The example of Norway (HM34), where municipal-level risk assessments are undertaken as a crucial input to municipal planning and development control, represents a good practice of how to integrate local risk assessment into municipal planning.

The portrayed good practice examples demonstrate the advantages of applying vertical governance structures for DRM as the national level risk assessment can support local level risk assessment and planning processes. At the same time these practices also highlight the need for principles for data and information sharing enhancing comparability between different hazard types and levels of government.

Business just like governments needs to know all the likely risks they may have to face before commencing the planning process. Developing organisation-wide situational awareness and establishing an ongoing business continuity program can help private sector firms cope with and be more resilient to hazard events. In May 2012 the International Standards Organisation (ISO) launched a business continuity standard, ISO22301, setting out the requirements for a Business Continuity Management System. These requirements can be applied by any organisation, irrespective of its size, type or location. Compliance with this standard signals that an organisation is prepared for managing disruptive events.

Harmonisation and linking of various sector-specific and/or hazard specific risk assessment methodologies are desirable. Alignment of methodologies could, for example, include flood risk assessment, climate risk assessment, critical infrastructure risk assessment, and offshore safety risk assessment.

When drafting methodologies or guidance for multi-hazard risk assessment, lessons can be learned from sector-specific and/or hazard-specific initiatives. Such harmonisation and linking of various existing risk assessment procedures requires close co-operation of all stakeholders involved. The critical infrastructure risk assessment, for example, is mandated by the EU Directive on Critical Infrastructure, but performed by the business operators.

To conclude, several governance attributes help facilitate successful integration of risk assessment into planning processes. These include vertical governance structures, enforcement via relevant embedding into national laws, sufficient capacities and resources at the local level to assess, plan and enforce restrictions, participatory approaches involving the general public in risk assessment and planning for greater policy acceptance, as well as effective data and information sharing among all involved stakeholders across governance scales and sectors. Additionally, harmonisation and linking of various existing risk assessment procedures from various sectors improves comparability and sharing of data and information across hazards and sectors. Furthermore, national level guidance to assist municipal planners to follow through the risk assessment process and how to

utilise its results in planning has proven an essential component for using risk assessments as a living document for policy planning.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for actions are proposed:

- **Promote the use of risk assessments for planning purposes at all levels of government.** The usage of risk assessments for informing the planning process ensures that all programming and policies are in line with risk priorities and that they are not counter-productive and even increase risk levels;
- **Stimulate business continuity planning for making the private sector more resilient**. Similar to public sector planning, business continuity plans typically cover the following areas: risk assessment, disaster recovery and business resumption planning, determination of recovery alternatives, validation of continuity plans, implementation of the plan, awareness raising and related trainings;
- **Strengthen methodologies for multi-hazard and single hazard risk assessment. A common approach and linking of various existing sector-specific and/or hazard specific risk assessment methodologies is desirable.** Alignment of methodologies could, for example, include natural and man-made risks such as flood risk assessment, climate risk assessment, critical infrastructure risk assessment, and offshore safety risk assessment;
- **Develop general guidance documents on how to carry out and use risk assessment, based on EU Guidelines and existing sectoral and hazard-specific risk assessment methodologies, to steer regional and local approaches and harmonise planning for DRM.** Guidance documents should help in meeting requirements of existing legislation (e.g. implementation of the EU Floods Directive), but also offer technical detail on common methodologies to be applied. Greater coherence in risk assessment and consequent planning allows for better comparability and thus easier data and information sharing and adoption of lessons learned across locations, levels of government and different types of hazards;
- **Ensure clear mechanisms are in place to link multi-hazard risk assessment with decision-making for DRM planning.** Feed risk information into wider economic and development planning, and particularly into local land use planning, where detailed understanding of multiple risk is particularly important;
- **Foster a culture of risk assessment wherein regular updates are carried out to account for potential changes in risk factors.** Such a culture requires that planning mechanisms are flexible and adaptive in order to respond to changing risks, and potential future planning needs;
- **Promote participatory approaches at all stages in the planning process.** Planning activities, and in particular risk assessment, needs to be as inclusive as possible, involving all relevant stakeholders from government, agencies, private sector, academia, as well as the general public.

Supporting practices:

- Norway's Planning and Building Act (HM34);
- Classified national risk assessment in the UK (HM63);
- New Zealand's National Hazardscape report (HM69);
- Regional system in Emilia Romagna, Italy (HM25);
- ISO 22301 standard for business continuity planning;
- Flood risk assessments practiced in the UK (FL100), Finland (FL26), France (FL31), Ireland (FL57) and Norway (FL62);
- Preliminary Flood Risk Assessments (PFRA) (FL100);
- French management plans for flood risk (PGRI) (FL31);
- Irish flood risk assessment and planning system (FL57);
- Flood prevention in planning in France (FL33) and Spain (FL82);
- Planning for industrial risk in Norway (IR36).

5.2.2 *Foster risk management planning for prevention*

A disaster risk management plan is a "planning instrument to foresee risks, to estimate their impacts, and to develop, select and implement measures to reduce, adapt to and mitigate the risks and their impacts cost-effectively" [166]. The primary goals of establishing risk management plans are to help raise the level of prevention by ensuring that a country takes informed actions to address the risks it is facing; foster the advancement of cross-sectoral DRM; better linking the various phases of the DRM cycle; and increase awareness and strategic investments in disaster prevention.

Planning for risk management is typically done within sectors, however, there is added value in bringing together the different sectoral efforts into a general overview and making them somewhat comparable across sectors. Multi-sectoral plans that involve a multitude of public and private stakeholders allow a better overview of risks and possible prevention measures. Prevention and preparedness measures to reduce risks could include technical, regulatory, financial or communication measures. Another goal of risk management plans is thus to set a framework for integrating different sector and hazard-specific risk management instruments into a common overall plan or planning framework. Thus, the implementation of the framework would allow for jointly organising and monitoring progress even if some instruments remain hazard/sector specific and cannot be scaled up to a multi-hazard approach. In this respect, a plan should always be backed up by an implementation action plan detailing the priorities and corresponding responsibilities, targets and timeframes. A good practice highlighting the benefits of risk management planning for prevention are the French risk prevention plans (Plan de Prévention des Risques (PPR))[167] (HM11).

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for actions are proposed:

- **Urge the development and implementation of risk management planning including prevention at all levels.** Increased use of risk management planning and risk management plans will help raise the level of prevention in the EU by ensuring that all MS take informed actions when deciding upon policies, projects and programmes relevant to DRM directly, or indirectly through sustainable development and other sectoral policies;
- **Encourage multi-sectoral planning or plans that address multiple hazards and are developed and implemented with active participation from a wide range of public and private stakeholders.** While typically risk management plans are carried out by sector, there is clear added value to frame and define overall national risk management planning, which can allow for prioritisation, comparing and learning from other sectors as well as across MS.

Supporting practices:

- French risk prevention plans (Plan de Prévention des Risques (PPR) (HM11).

5.2.3 *Encourage the use of appropriate specific sectoral and single-hazard assessment methods and technologies, such as hazard mapping, micro-zoning, risk modelling, construction codes and early warning systems, to aid the risk assessment and planning procedures*

The use of appropriate specific methods and technologies can aid the risk assessment procedure and refine its accuracy. These include, for example, hazard and/or sector specific micro-zoning, hazard mapping, construction codes, remote sensing, geographic information systems, as well as *in situ* and space-based earth observation systems and early warning.

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[166] Council of the European Union. Explanatory note on Disaster Risk Management Plans (DS1277/12). 16 April 2012. Art.4.

[167] http://www.risquesnaturels.re/risques/plan-de-prevention-des-risques-ppr.

Land use planning guided by regularly updated risk assessments and hazard mapping and/or micro-zoning exercises can help increase resilience by appropriately citing critical infrastructure and housing outside of high risk areas. This is in line with one of the HFA's strategic goals of developing, upgrading and encouraging the use of guidelines and monitoring tools for reducing risk in the context of land use planning.

For hazard mapping to function effectively, good communication and co-operation between regions/cities and the national government needs to be in place. Such integrated governance also strengthens institutional capacity and multi-stakeholder dialogue. The application of existing *in situ risk mapping* (such as JRC's EFFIS), and space-based earth observation systems remote sensing, geographic information systems, in combination with weather, climate and hazard modelling and forecasting tools is thus a good practice measure in fire risk mapping that can be relevant for other hazard types and could be utilised throughout Europe.

While seismic hazard mapping (macro-scale) takes into account the distribution of seismic hazard over an entire country or region, seismic micro-zoning takes into account the effect of local site conditions i.e. the detailed distribution of earthquake risk within each seismic zone. Micro-zoning is too time-consuming and knowledge-intensive for being considered for scale-up to a multi-hazard level minimum standard. Most authorities in charge of DRM do not dispose of adequate resources, both in terms of money and manpower, to carry out large-scale micro-zoning efforts. However, it is an important measure that can certainly help guide planning processes for earthquake risk reduction and should therefore be encouraged. For seismic hazard mapping to function effectively, good communication and co-operation between regions/cities and the national government needs to be in place. A common reference methodology facilitates such communication and co-operation considerably.

Risk modelling can serve as a powerful analysis tool as it can focus on various different elements, such as prospective approaches to look into future risks due to climate change, for example, or modelling specific geographic scales such as urban risks. As such this methodology thus allows policy-makers to gather tailor-made, needs-based risk assessment results from a basic data set. Such differentiation of modelling outputs is necessary to crosscheck policy options for their potential impacts for example. As with the other specific tools and methods, it is essential that the results of risk modelling are actually used as a tool for planning.

Construction codes can serve as a key tool for directing planning for greater resilience across various hazard types. Practices applying strict construction codes based on local risk assessments are in line with HFA priorities on encouraging the revision of existing or the development of new building codes, standards, and reconstruction practices, as well as reinforcing the capacity to implement, monitor and enforce such codes. The Eurocodes – a set of standards with common rules for structural design, in particular Eurocode 8 on seismic design of buildings, offer an excellent opportunity for the standardisation of such codes across Europe. National implementation of the Eurocodes needs to be further encourages and progress monitored. In addition, building codes should not only address new buildings but also apply when retrofitting is carried out. To enforce the application of building codes, the use of inspections and monitoring throughout the building process could be promoted.

When considered as a prevention tool, complete and effective early warning systems should comprise knowledge on the risk, i.e. be linked to detailed risk assessment, include an operational monitoring and warning service, have well-functioning dissemination and communication capacities,

and possess sufficient response capability.[168] National, regional and local EWS systems could benefit from EU guidelines regarding minimum requirements for these components. Risk scenarios should be defined and reviewed periodically. A clear line of responsibilities throughout the chain should be agreed and implemented. Improvements to the early warning system should be based on the experiences and on the study of the past events. Manuals and procedures should be published. Communities should be consulted and information disseminated. Operational procedures such as evacuations should be practiced and tested. For multi-hazard EWS, clear lines of authority and responsibilities as well as firm embedding into governance structures across all levels are a pre-requisite for co-ordination across different hazards. Command structures for the issuance of alerts need to be established and transparent. Information needs to reach all actors simultaneously across all different levels, ranging from local to national level as well as the general public. Participatory approaches for improving the response capability phase of early warning are promising tools for effectively involving the general public for the purpose of transmitting early warning messages. For example, the Integrated Observations from NEAR Shore Sources of Tsunamis (NEAREST) EWS prototype in Portugal (EQ24) takes interaction with climate adaptation in the light of climate change impacts and decision-making under long-term uncertainty. It highlights the importance of establishing clear mechanisms for co-ordination across scales and sectors when implementing multi-hazard EWS, including information flows and engagement of a wide range of research institutes, universities, scientific community, and stakeholders at national and international level.

Another important aspect to be considered when dealing with early warning is the information exchange across borders. The METEOALARM project (HW4), for example, gathers information on all existing national early warning systems and aims to communicate warnings across the participating Member States. Citizens can access the portal and the idea is to also look into cross-border hazards, but currently even standards on how to warn citizens about a big storm, for example, are very different on both sides of the Rhine River (France versus Germany). European guidance could be formulated on the topic of harmonising early warning systems and improve data and information sharing to improve cross-border prevention efforts.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for actions are proposed:

- **Reinforce capacities at relevant levels of government (national, regional, local) to implement, monitor and enforce specific DRM planning mechanisms, such as zoning of critical infrastructure or building design codes;**
- Put in place good communication and co-operation between regions/cities and the national government to foster risk mapping, for example of fire risk;
- **Encourage regular updating of existing or the development of new building design codes and standards at the national or local levels, as appropriate, as a key tool for directing structural planning for greater resilience;**
- **Foster a common approach to international standardisation of micro-zoning techniques, including parameters, methodologies and technologies, and encourage their application on a large-scale basis.** If techniques are standardised internationally, large-scale application can become more cost-effective due to time-savings of applying a pre-defined methodology and technology and economies of scale in terms of knowledge and training requirements for micro-zoning professionals;
- **Develop Probabilistic Seismic Hazard Assessment (PSHA) and mapping to be the reference methodology for seismic zonation and seismic action levels of the National Annexes of**

[168] UNISDR, 2006. Developing Early Warning Systems: A Checklist. (http://www.unisdr.org/2006/ppew/info-resources/ewc3/checklist/English.pdf).

Eurocode 8. The implementation of a common reference methodology helps support the standardisation of the quality of buildings and critical infrastructure across Europe, as well as the harmonisation of national seismic activities;

- **Promote the use of risk modelling as a powerful analysis tool for tailor-made, needs-based risk analysis for guiding policy decisions.** While noting that it is subject to uncertainty, risk modelling can inform the analysis of future risks many years into the future, take into account climate risk into policy scenarios, or focus on a very specific geographic locality, such as urban risks;
- **Address implementation deficit of Eurocode 8, possibly via the introduction of inspections and monitoring throughout the construction process;**
- **Promote research efforts and further harmonisation of early warning systems in their role as a planning tool for prevention.** Concretely, EWS for preventive purposes needs to portray the following components: knowledge on the risk, i.e. be linked to detailed risk assessment, include an operational monitoring and warning service, have well-functioning dissemination and communication capacities, and possess sufficient response capability. The EU should play a role in co-ordinating such research and harmonisation efforts, taking on guiding role for national, regional and local level EWS systems;
- **Assure continuous improvement and functioning of databases and the sharing of access to data and information that EWS depend on between all relevant levels of government within one country, cross-border and internationally;**
- **Ensure that EWS are sufficiently location-specific so as to be sensitive to cater to the population they intend to warn, i.e. understandable communication taking into account culture, livelihood characteristics, vulnerable groups, gender, etc.**

Supporting practices:

- PSHA in Portugal (EQ14);
- Applied research project on seismic micro-zonation methodology in Turkey (EQ8);
- Fire risk mapping in Italy (FF13);
- UK Foresight Programme;
- UK Climate change risk assessment (HM66);
- FP7 funded MATRIX project (New Multi-Hazard and Multi-Risk Assessment Methods for Europe);
- Global Earthquake Model (GEM);
- Eurocode 8 (EQ13);
- Irish flood protection of buildings (FL54);
- Vigilance system in France (HM13);
- Integration of early warning into flood risk management (FL49, FL51, FL35);
- Forest fire early warning systems in Germany (FF10) and Italy (FF13);
- METEOALARM project for heatwaves (HW4);
- NEAREST EWS prototype (integrated observations from near shore sources of tsunamis: towards an early warning system);
- CEA/DAM (EQ38);
- IERREWS (EQ11).

5.2.4 *Ensure risk prevention proofing of new investments*

Good practices in Europe show a clear potential for the EU to play a role in steering its investments towards mainstreaming disaster prevention considerations for new infrastructure and/or development projects. Essentially, this means that the EU would ensure all its investments whether it be co-financing of projects, State Aid or investments via Structural Funds, etc. will not be increasing disaster risk, and if possible will include components for preventing risk.

Such ‘prevention-proofing’ of investments can be ensured via relevant criteria for design, approval and implementation of new programmes, projects or funding streams. For example, the use of Cohesion Policy funds for risk prevention offers a means for guiding investments, in this case co-funding, to where the immediate consequences of disasters are typically felt: the local and regional levels and their authorities. The Commission's proposals for the funds under the Common Strategic Framework for the period 2014-2020[169] include strengthened provisions on disaster management and introduce conditionalities. These provisions set the basis for mainstreaming disaster resilience and risk management in all actions and thematic priorities (for instance, making sure that all newly built or rehabilitated infrastructure is disaster proofed and can also face emerging risks). To encourage better prioritisation of the funds according to the risks faced by each country, a condition under the Cohesion funds requires "national or regional" risk assessments taking also into account the impacts of climate change which would help the country identify the risks and also the caps in its disaster risk management capacities.

While the Cohesion Policy funds demonstrate how to leverage funding streams for encouraging the creation of projects focusing on risk prevention, other EU level instruments can be leveraged to ensure that decision makers consider the ensuing disaster risk impact when deciding whether to proceed with an investment, namely the environmental impact assessment (EIA) and strategic impact assessment (SEA) Directives. These have already been firmly established as an integral part of the planning and decision-making process regarding new investments throughout Europe. The projects and programmes co-financed by the EU (e.g. Cohesion, Agricultural and Fisheries Policies) have to comply with the EIA and SEA Directives to receive approval for financial assistance. [170] Thus, the Directives are crucial tools for providing strong impetus on how prevention practices on a national or regional level are being directed. While their implementation is not per se a good practice given their obligatory nature, EU Member States can be encouraged to go beyond the requirements and consider the related risks associated to new projects and their vulnerability to natural and man-made disasters.

As regards plans and programmes which are likely to have significant effects on another Member State, the Member State in whose territory the plan or programme is being prepared must consult the other Member State(s). On this issue, just as the SEA Directive follows the general approach taken by the SEA Protocol to the UN ECE ‘Convention on Environmental Impact Assessment in a Transboundary Context’, similar protocols can be developed in relation to disaster prevention evaluations in a transboundary context.

Such efforts on guiding investments are in line with HFA goals and priorities, which also emphasise the importance of mainstreaming disaster risk considerations into planning procedures for major infrastructure projects. Mainstreaming risk considerations into evaluation grids for new investments can be combined with similar mainstreaming criteria for climate awareness. The Red Cross Red Crescent Climate Centre has recently published a proposal for ‘Minimum Standards for local climate-smart Disaster Risk Reduction – enabling integration of local capacities into national climate adaptation strategies’. In this document, a similar minimum standard on mainstreaming is proposed: new programs should consider a level of ‘acceptable risk’ in project design, including physical infrastructure, and incorporate predicted trends in climate change into project plans.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for actions are proposed:

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169 COM(2011) 615 final.

170 http://ec.europa.eu/environment/eia/review.htm.

- **Guide EU, national and private investments to account for disaster risk by applying disaster prevention considerations via relevant criteria for design, approval and implementation of new programmes, projects and funding streams;**
- **Encourage MS to make use of available funds from EU Cohesion policy as well as other available EU funding programmes.** Despite dedicated themes of disaster prevention uptake of Cohesion policy funding for disaster prevention currently has been limited. To counter this trend, in their partnership agreements with the EC, MS should take advantage and effectively use the funds for investments in DRM and climate change adaptation;
- **Build prevention proofing measures into national funding programmes;**
- **Link prevention proofing and climate proofing efforts whenever possible.**

Supporting practices:

- Fire risk mapping in Italy (FF13).

5.2.5 *Foster integration of DRM into post-disaster recovery actions*

In the rehabilitation and recovery phase of the disaster management cycle it is important to address underlying vulnerabilities that had previously prevented safe construction and therefore limited durability and sustainability of infrastructure. To this end, emphasis should be placed on "building-back better" actions, such as improved infrastructure that will be more resistant to future events, or relocation of infrastructure to safer areas. Building back to a better standard that is less vulnerable to context-specific hazard will contribute to reduced risks in the long-term. Reconstructed or rehabilitated infrastructure with future risk in mind will prove more sustainable. "Build-back better and greener" approaches should be implemented within a framework of local and national risk assessment (i.e. mapping the areas at risk and unsafe infrastructure) improvement of building practices and skills, improved and more resilient building materials and techniques, and contingency planning for subsequent disaster events.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for actions are proposed:

- **Link national and EU financial assistance granted in the recovery phase directly to an obligation to introduce "build back better" approaches**. "Lessons learned" actions in the recovery and reconstruction phase build an essential building block for reducing future vulnerabilities and fostering more resilient communities. Building back to a better standard that is less vulnerable to context-specific hazard will contribute to reduced risks in the long-term.

Supporting practices:

- Catania guidelines for repair, improvement and reconstruction of damaged buildings from earthquakes (EQ62);
- Green Recovery Partnership for recovery phase post-2004 South Asian Tsunami.

5.2.6 *Develop innovative financing mechanisms*

Well-structured and balanced financing mechanisms for DRM create trust, certainty and continuity of the planning process, and particularly its implementation. Financing mechanisms are intricately linked to planning processes in two ways: on the one hand, planning for policies and measures heavily depends on the type of financing it is backed by; and on the other hand, linking planning for DRM directly to financial incentives triggers a more prevention-focused behaviour, thus increasing community resilience and indirectly decreasing financial and insured losses that would otherwise be experienced in the event of a disaster. The latter is commonly referred to as risk transfer whereby

costs are associated with what the government has done with prevention prior to the hazard event, but also how the private sector (insurance) can provide the right incentives such as risk premiums.

Important links between risk management planning and financing issues have been firmly established in the literature and via good practice[171]. First of all, the development of effective risk financing strategies at the national level, as with many other components of DRM, depend on the quality of risk assessment because it requires a thorough understanding of risk exposures and consequent financial vulnerability. Second, the G20/OECD methodological framework also encourages the factoring in of risk assessment into overall financial strategies to ensure the appropriate allocation of resources for targeted ex post investments in risk reduction measures and "build-back better" upgraded infrastructure. At the same time, financing mechanisms and risk transfer can also reinforce risk assessment and support other components of DRM because private insurance companies have strong incentives to perform their own risk assessments and thus generate updated data on hazards, exposures and vulnerabilities.

Even though Member States throughout Europe are exposed to different types of disaster risks and existing risk insurance systems are highly diverse, risk insurance can benefit from following some common principles. Namely, these principles include 'solidarity', 'co-operation' and 'compensation'. Public-private partnerships for risk transfer under the principle of solidarity build a solid basis for functioning risk insurance systems. 'Responsibility sharing' and good co-operation for prevention measures between public and private stakeholders is an important step towards affordable insurance. A risk insurance system covering multiple-hazards is preferable to a single-hazard based system as it provides greater societal reassurance and can spread costs across more actors. Pay-out independent of official disaster declaration can help alleviate immediate needs for compensation among the most vulnerable population. The Spanish national risk insurance system is a particularly good practice portraying detailed application of these common principles. The good practice therefore represents a solid base for establishing common ground in disaster risk insurance across the EU.

Direct and clear links of insurance risk premiums to disaster prevention provides greater incentives within the insurance system to invest in prevention measures rather than compensation for encountered damages. The adoption of risk-based premiums might reduce the moral hazard and lead to a better understanding of the development of risk among the public. Otherwise if insured, disaster prevention may cease to be a priority for people. This should be combined with organising effective consumer education and public information campaigns. In the USA, for example, the national flood insurance programme is voluntary and connected to mitigation measures. This is very important because citizens have to commit to mitigation measures to lower their premium if they want to be insured.

Finally, in order to continue to foster such creativity and diversity in finding the best possible way forward, there is a need for finding innovative instruments for the financing of disaster prevention, and overall DRM activities in more general. Such fostering of innovative solutions is supported by the Council Conclusions on Innovative Solutions for Financing Disaster Prevention presented in November 2010.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for actions are proposed:

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[171] http://www.oecd.org/mexico/g20oecdframeworkfordisasterriskmanagement.htm.

- **Raise awareness regarding the important links between risk management planning and financing issues.** A better understanding of these interlinkages will allow for leveraging risk analysis for better guiding financing mechanisms, while at the same time utilising information generated from financing sources, such as disaster loss data, to improve the accuracy of risk assessment information;
- **Encourage public-private partnerships for risk transfer to support planning backed up by a solid risk insurance system.** Clear opportunities for public-private partnerships and the important role of the private sector in financing disaster prevention need to be sought after. Such partnerships can offer clear cost advantages via risk transfer and risk pooling;
- **Use incentives such as insurance risk premiums to foster disaster prevention measures**. Mechanisms should be encouraged to structure insurance premiums so that they provide greater incentive for undertaking disaster prevention measures;
- **Foster 'responsibility sharing' for prevention between stakeholders as a principle of sustainable and affordable insurance**. Various stakeholders (e.g. governments, private companies, insured parties) all take part in minimising and adapting to increased disaster risks;
- **Prioritise risk insurance systems covering multiple-hazards to a single-hazard based system as it provides greater trust in the system among society and can spread costs across more actors;**
- **Promote risk insurance standardisation products and processes based on common principles across Europe, including harmonisation of post-disaster assistance policies, as well as education and public information campaigns, while at the same time allowing sufficient flexibility for Member States to pursue tailor-made risk insurance solutions;**
- **Encourage pay-out independent of official disaster declaration.** This helps alleviate immediate needs among the population;
- **Foster continuous creativity and diversity in finding the best possible way forward for financing disaster prevention.** There is a need for finding innovative instruments for the financing of disaster prevention; the topic is still widely discussed and it can benefit from further good practice comparison to distil the most innovative and effective for financing in the future.

Supporting practices:

-G20/OECD methodological framework publication;

For more information see:

http://www.oecd.org/mexico/g20oecdframeworkfordisasterriskmanagement.htm;

- Spanish disaster risk insurance system (HM48)

For more information see:

http://www.wfcatprogrammes.com/c/document_library/get_file?folderId=13442&name=DLFE-553.pdf;

- French national system for indemnification of natural catastrophes (HM16)

For more information see:

http://www.wfcatprogrammes.com/c/document_library/get_file?folderId=13442&name=DLFE-553.pdf;

- Belgian national risk insurance system (HM3)

http://www.wfcatprogrammes.com/c/document_library/get_file?folderId=13442&name=DLFE-553.pdf;

- National Flood Insurance Programme, USA

For more information see: *http://www.fema.gov/national-flood-insurance-program/flood-insurance-library.*

5.3 Guideline: Risk communication – Promoting an integrated approach to awareness raising, education, and capacity building for authorities and communities

Risk communication aims to influence thinking and behaviour related to risk. It is intimately linked to capacity building on an individual, community and organisational level. On an individual level it can be used to generate knowledge on how to interpret and act on risk information. On a community

level it can be used to create ownership in communities on communicating risks and enable co-operation among individuals, groups and organisations[172]. Moreover, a precondition for authorities and communities to manage and prevent risk, is access to accurate and timely information. Given the often-decentralised organisation of DRM, local authorities and risk managers in particular need the know-how and technical knowledge on how to translate often-complex data into appropriate measures. Consequently, risk communication and capacity building are two sides of the same coin, both reinforcing each other in making DRM more effective.

There are two main challenges to create an integrated approach to risk communication that includes awareness raising, education and capacity building:

The first challenge is to provide individuals and communities with easily interpretable and readily available information on resilience building. People in high-risk areas must be prioritised, in particular vulnerable groups such as children, the elderly and women. There are many possible actions available to ensure that this type of information is disseminated. First, more conventional methods must be used such as the mainstreaming of DRM into school curricula and feeding media outlets such as newspapers. Second, the spread of Internet connectivity allows for massive potential in reaching large amounts of people within a few mouse-clicks and enables authorities to set up web-pages and portals to communicate risk. Third, technological advances in smart-phones and social media such as Twitter, opens the door to more unconventional methods for reaching citizens in order to raise awareness, as well as provide real-time information on disaster risk levels and appropriate actions. Fourth, local, regional, and national media outlets are generally a first stop for people to get information. Media should therefore be enabled and engaged in supporting disaster risk awareness raising.

The second challenge is to capacitate planners, emergency managers, and relevant local government staff to interpret data and formulate action to reduce risk. The key is to facilitate collaborative and participative approaches that engage scientists, experts and authorities in dialogue and training towards optimal DRM. It goes hand-in-hand with previous DRM guidelines on cross-border co-operation in risk prone areas and vertical collaboration across administrative levels of government between national, regional and local authorities.

The following sections zoom in on integrated awareness raising, education and capacity building, in particular: (1) tailoring awareness raising campaigns to their audience; (2) encouraging participative approaches toward learning and capacity building; and (3) ensure that staff in local authorities have the appropriate training and know-how to deal with DRM.

5.3.1 Tailor awareness raising and information campaigns to different audiences

Awareness raising and improving knowledge of disaster risks and how to prevent them among citizens of all ages and occupations, including the most vulnerable groups, are central to implementing effective DRM. In hazard prone areas in particular, people need to understand the risk involved with, for example, floods, storms or heat waves and what can be done to prevent or mitigate those risks. People acquire knowledge about risks in different ways depending on their interests, vulnerability, age and social context. A central task for risk communicators is to tailor awareness raising and information campaigns to their target audience.

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[172] Höppner, C, Bründl, M and Buchecker, M., 2010. Risk Communication and Natural Hazards. CapHaz-Net WP5 Report, Swiss Federal Research Institute WSL. (available at: http://caphaznet.org/outcomes-results/CapHaz-Net_WP5_Risk-Communication.pdf).

Education is key to reducing social vulnerability, in particular among children[173]. Teaching children is an investment for "life-long" knowledge and children may be the most effective transmitter of knowledge between institutions for education and homes and society in general. School children benefit from mainstreaming DRM into school curricula to enhance their understanding of risk from a young age. Children are the most receptive at preschool age and communicating risks therefore benefits from an early start. Learning is an iterative process, therefore requiring repetition and should target also children and youth in primary/secondary schools as well as youth at university. Training programmes should therefore be tailored to different age groups ranging form preschool to university. Moreover, mainstreaming can only be achieved by supporting teachers in their day to day classroom plans to teach about disasters, risks and resilience by providing them with appropriate training, support and material.

Innovative education approaches often encourage participation where participants are part of identifying and assessing risks along with suggesting measures to prevent them. In France, for example, the Memo'Risk initiative (HM12) engages school children to go out into their local surroundings and survey risk. It creates understanding among the participants and provides valuable information for local authorities to measures risk perceptions. In Italy, the EDURISK (EQ77) project engages school children (and other parts of the communities) and technical experts in dialogue on seismic risks. The project then creates tools that correspond with the context of different target groups based on age (infant, primary, lower and higher secondary school) to provide the information in an accurate way. Memo'Risk and EDURISK are good examples of how win-win measures can be designed to benefit community awareness and resilience as well as feed policy making by gathering information on knowledge levels and learning patterns of different groups.

The tailoring of information to other groups such as those who are vulnerable (including people who are elderly, handicapped, women and homeless) as well as occupational groups requires using other means for reaching the target. Vulnerability can be identified and assessed at a community, social group or individual level and is a first step towards a better understanding of how to design information campaigns. The information needs to be delivered via different media such as newspapers, the Internet and social media. Conventional media such as newspapers, pamphlets and signposts are generally good for creating long-term understanding and internalisation of knowledge. It can also, however, be used to inform vulnerable groups such as tourists and homeless. For communities where Internet connectivity is high, Internet portals and homepages have proven particularly useful for spreading real-time information on risk levels and preventive actions to a wider public. Finally, to reach even more citizens, the use of other means such as mobile phone applications and social media has demonstrated innovative ways to reach an extended group of people.

Moreover, to help them increase their resilence to natural disasters, there should be an increase in capacity among sectors such as business sectors. In the UK, for example, programmes have been launched on how businesses can prevent unnecessary losses caused by data-loss, electricity shortages, floods and fire, measures often labelled as 'business continuity planning'[174].

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[173] 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: Ljubljana (available at: http://caphaz-net.org/outcomes-results/CapHaz-Net_WP6_Risk-Education).

[174] Cabinet Office, 2012. Business continuity guide launched. See: http://www.cabinetoffice.gov.uk/news/business-continuity-guide-launched.

Based on the abovementioned basic principles and evidence from GPs, the following guidelines for action are proposed:

- **Campaigners and authorities responsible for information dissemination should ensure that integrated information and awareness-raising campaigns are designed to meet the needs of different groups in society, including vulnerable groups, by identifying the needs and information channels most effective for spreading information on DRM**. Groups in society have different predispositions to prevent and deal with risk. The context therefore needs to be understood and accommodated when designing and implementing risk communication;
- **Identify and target the most vulnerable groups in society and capacitate them to understand what measures can be taken to prevent disasters**. Children, elderly, tourists, handicapped, homeless and women can be particularly vulnerable to disasters. Their needs and channels to acquire information are essential to understand for community risk communication;
- **Integrate DRM in school curricula by providing material for teachers to communicate with school children and adolescents in the most appropriate way**. School children are particularly susceptible to information and may be used to induce life-long learning and the spread of information to homes, families and thereby other parts of society;
- **Develop, update and maintain an online portal or webpage for information on all types of disaster risks and how to prevent them.** The fast spread of the Internet as a source of information for many people and as an interface between citizens and authorities requires communicators to ensure that online tools and data are made available and updated to the furthest extent;
- **Support innovative and unconventional approaches to information dissemination and awareness raising**. The increasing use of current and new technology opens up innovative ways to spread risk communication and data. For example, smart phones and social media have already generated several community initiatives to prevent disasters and speed up the information flow to citizens.

Supporting practices:

- French Memo'Risks initiative (HM12)

For more information see: UNISDR (2010) Local Governments and Disaster Risk Reduction Good Practices and Lessons Learned. Can be downloaded at: http://www.preventionweb.net/files/13627_LocalGovernmentsandDisasterRiskRedu.pdf;

- Sweden'a approach to preparing the individual's role in DRM (HM54)

For more information see: https://www.msb.se/sv/Forebyggande/Sakerhet-hem--fritid/;

- EDURISK (EQ77)

For more information see: *http://www.edurisk.it/.*

5.3.2 *Encourage participatory approaches and volunteering in awareness raising and education*

Participatory approaches in communicating risk have become increasingly recognised as a necessary component in good DRM. "Communication is understood to encompass many forms and purposes of flow of information between the different actors involved in risk governance and to include different modes of interaction, participation and partnership rather than only flows of 'expert to nonexpert' information", argues Walker et alt (2010)[175]. It highlights the importance of involving stakeholders in the very creation of knowledge as well as planning, implementation, monitoring and evaluation. Participatory approaches to awareness raising could increase effectiveness of DRM measures by linking theory and practice, increasing trust among stakeholders, and creating

[175] Walker, G; Whittle, R; Medd, W & Watson, N, 2010. Risk Governance and Natural Hazards. CapHaz-Net WP2 Report, Lancaster Environment Centre, Lancaster University: Lancaster (available at: http://caphaz-net.org/outcomes-results/CapHaz-Net_WP2_Risk-Governance.pdf).

understanding of different attitudes and viewpoints. If carried out correctly, it fosters ownership of DRM and a culture of resilience while providing feedback to risk managers on knowledge levels and local contexts to enhance future activities. Furthermore, participation often goes hand-in-hand with volunteering and the mobilisation of communities. GPs in Europe show how many authorities have seized the opportunity to work together with citizens and experts to develop awareness raising campaigns by identifying the risks and working out appropriate responses in collaboration. It is also easy to find initiatives that engage large numbers of volunteers, for example with flood prevention.

Participatory approaches can take many forms. In the aforementioned French Memo'Risk initiative, for example, the use of participatory approaches show how win-win situations are created when school children are engaged to think about disaster planning and disaster risk managers are able to survey the level of understanding among children. If properly implemented, the participatory approach could create feedback loops where training programmes and information campaigns are improved by making people a part of the knowledge creation.

Participation by community representatives in planning and implementation can also be included in legislation. On a European level, for example, the WFD and the Seveso Directive include provisions making it mandatory to ensure participation, right to information and access to information in decision-making processes. On a national level, the French Bachelot law implementing the Seveso Directive requires local councillors to be involved in the development in hazardous plants. The community is represented at the planning stage by a committee consisting of citizens, industrial owners, local authorities and the State Citizens' right to information on potential risks of industrial installations and how to behave in case of accidents is strengthened under Seveso III, where Article 15 emphasises citizens' rights[176].

Participation in DRM, however, is in many cases supported through voluntary action and not by legal instruments. A particularly important and useful approach is to encourage volunteering in communities. Volunteers are in general highly beneficial to disaster prevention given that no society can afford a fully qualified disaster response to always be available. NGOs such as the Red Cross are well-known for filling these functions worldwide. Moreover, in awareness raising and training, the use of volunteers is particularly helpful. The training and enrolment of local volunteers is, in a sense, a participative approach for people to engage in their local surroundings and creates ownership of disaster risk challenges. It also encourages learning and allows for community-based approaches to training and capacity building, where trainers may acquire knowledge and understanding of the local context, which thereby enables targeted information campaigns to be developed.

Based on the abovementioned basic principles and evidence from GPs, the following guidelines for actions are proposed:

- **Ensure that communities participate in planning, implementation, monitoring and capacity building**. Communities need to be aware of the risks that surround them and how to best prevent them. Engaging people encourages ownership and willingness to take responsibility in monitoring, training and evaluation activities;
- **Implement feedback mechanisms in training and capacity building, to ensure improvements in materials and content for future participants**. The participation of communities offers an opportunity to survey local conditions, emotions and knowledge levels relevant to DRM;

[176] Directive 2012/18/EU On the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC.

- **Promote the adoption and implementation of legal instruments that ensure citizens' participation (or representation) in DRM and access to information on potential risks to their community.** In some cases, participation has to be included in legislative instruments. This is the case as regards industrial hazards, where the Seveso Directive makes public participation in land-use planning decisions and information of the public mandatory;
- **Support participation by volunteerism**, volunteers can complement the resources of local authorities and fill an important role. Volunteerism should be supported at all levels as an effective, low-cost and participative force in DRM.

Supporting practices:

- APELL (Awareness and Preparedness for Emergencies at Local Level) (IR62)
  For more information see: *http://www.grida.no/publications/et/ep3/page/2628.aspx*;
- French Memo'Risks initiative (HM12)
  For more information see: UNISDR (2010) Local Governments and Disaster Risk Reduction Good Practices and Lessons Learned. Can be downloaded at: http://www.preventionweb.net/files/13627_LocalGovernmentsandDisasterRiskRedu.pdf;
- Deutsche Lebens-Rettung-Gesellschaft (DLRG)
  For more information see: http://www.dlrg.de/;
- Flood Awareness Raising campaign, UK (FL95)
  For more information see: *http://www.environment-agency.gov.uk/homeandleisure/floods/default.aspx*.

5.3.3 Ensure that authorities and media have the required knowledge and capacity to implement DRM policies

Authorities in charge of DRM have an obligation to prevent disaster risks. Often based in agencies on the national, regional and local level, the staff in these authorities must have adequate knowledge on how to draw up and implement strategies for DRM. Data on disaster risks is often technical and complex and translation these into what action is needed is not always straightforward. Prevention efforts are therefore dependent on the capability of staff in authorities to translate data into action. In the UK, for example, the staff at the British Environment Agency receive training courses on technical parts of flood forecasting and warning, and being a flood warning duty officer (FL96). Moreover, in both Spain and Denmark there are good examples of trainings for staff in different disaster risk relevant authorities, such as fire departments, emergency managers, planners and local authorities.

The translators of hazard information to the public are often journalists, who need to be enabled with the appropriate understanding and ability to make informed judgements of risk communication. Currently journalists play an ambiguous role in supporting effective DRM and reporting is often based on sensationalism and newsworthiness instead of preventing negative effects from hazards. Journalists must therefore be trained in how to interpret and report on disasters in a correct manner[177].

Based on the abovementioned basic principles and evidence from GPs, the following guidelines for actions are proposed:

[177] 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: Ljubljana (available at: http://caphaz-net.org/outcomes-results/CapHaz-Net_WP6_Risk-Education).

- **Capacitate media and journalists to disseminate appropriate information on DRM by providing trainings and materials on how to interpret, report on, and spread information on disasters.** Media and journalists could be effective promoters of DRM by reporting on disasters. Reporting can trigger political action and public willingness to more actively engage in disaster risk management. To support this process, however, journalists need training on how to report on disasters and for example, what terms to use and where to find information;
- **Encourage capacity-building and prevention training of professionals working in agencies and bodies responsible for DRM at all levels.** This is vital to ensure that disaster prevention is given sufficient attention compared to response and preparedness as part of emergency management.

Supporting practices:

- DEMA Emergency Services College (IR7)

For more information see: http://brs.dk/omstyrelsen/opgaver/tekniskskole/Pages/Forside.aspx

Guide for journalists covering disaster risk reduction;

- UNISDR (2011) Disaster through a different lens: Behind every effect, there is a cause. A guide for journalists covering disaster risk reduction. Available at: http://www.preventionweb.net/files/20108_mediabook.pdf.

5.4 Guideline: Develop multi-hazard, multi-scale (context-specific) disaster loss databases for informing DRM processes in Europe

A first step in DRM is the assessment and characterisation of key risk factors. To understand and manage risks appropriately requires observing and recording hazards and studying exposure and vulnerability. Therefore, disaster loss databases with validated data and inventories represent an essential basis to build upon and implement efficient and effective DRM policies and programmes. Due to the 'public good' nature of most disaster-related information[178], governments play a fundamental role in providing high quality and context-specific risk information, such as the geographical distribution of people, assets, hazards, disaster impacts, etc., to support DRM[179]. This entails regular updating of information due to the dynamic nature of disaster risk, especially in light of a changing climate and associated uncertainties. However, country- and context-specific disaster impact and loss data is often incomplete or of low quality. Even in countries with reasonably good information available on direct impacts, data on social and environmental losses is limited[180].

A number of ongoing efforts representing GP on international and regional levels demonstrate several common features that are important for developing a well-functioning, high quality disaster loss database that can inform the policy process. These GPs range from global coverage disaster loss and impact databases, such as CRED's EM-DAT[181], Munich Re's NatCatService[182] and Swiss Re's Sigma CatNET focusing on national scale disasters, to regional systems such as UNISDR's DesInventar[183] including large, medium and small scale disasters, as well as sector-specific initiatives, such as the eMARS[184] database for reporting accidents and near misses according to

178 Benson and Clay (2004) – CC report.

179 McBean, G.A. 2008 'Communicating to Policy Makers Climate Science with its Inherent Uncertainties' in Kyoto: Ten years and still counting ed V. Grovers (Science Publishers, Enfield, New Hampshire, USA) 621-643.

180 Benson and Clay (2004) – CC report.

180 McBean, G.A. 2008 'Communicating to Policy Makers Climate Science with its Inherent Uncertainties' in Kyoto: Ten years and still counting ed V. Grovers (Science Publishers, Enfield, New Hampshire, USA) 621-643.

181 www.cred.be.

182 http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx.

183 www.desinventar.net.

184 http://mahb.jrc.it/index.php?id=39.

the Seveso II Directive, the EFFIS[185] established by the JRC and DG Environment for supporting agencies in charge of protecting forests against fires in the EU, the EFAS[186] for Europe-wide probabalistic flood information and the GDACS[187] for co-operation between the EC, the United Nations and disaster managers worldwide to improve hazard alerts and information sharing as well as improved co-ordination.

The following sections capture the various minimum components necessary for setting up a multi-hazard disaster loss database that can be utilised at various scales from European, to national to local levels for effectively informing DRM processes. More specifically, these minimum required components are: (1) foster an enabling environment for the effective implementation and functioning of disaster loss databases, (2) develop multi-hazard, multi-scale disaster loss databases that are context-specific for informing DRM in Europe, (3) work towards harmonising terminologies, input variables and methodologies for data collection, validation and analysis and (4) utilise ICT for facilitating international exchange and dissemination of the disaster loss data and information.

5.4.1 Foster an enabling environment for the effective implementation and functioning of disaster loss databases

In order to ensure that disaster loss databases reach their intended goals, it is essential that the database is embedded in an enabling environment that makes the system work. GPs have shown that such an environment, though partly location specific, exhibits various key features.

Ownership of the database by a government or public sector agency with clear links for utilising the database in DRM, represents the most direct way of ensuring an enabling environment and continuous support for its implementation. Implementation outside the public sector could also be an option, if public-private partnerships are fostered so as to be able to include all the input variables and scale adjustability required for the database to generate information for informing the policy process. Such public-private partnership options could represent – in some cases – a cost-effective alternative. One caveat that needs to be taken into account though, is the fact that often private databases such as those of Munich Re and Swiss Re, are geared toward a slightly different purpose and may therefore only include insured losses, for example, and the methodology used to calculate the data is not shared by insurance and reinsurance companies.

The database, wherever it is hosted, needs to form an integral part of DRM as a central tool for governments at all levels to better understand risks in order to effectively manage them. Counterpart agencies and human as well as financial resources, need to be identified at all levels of government. The process of developing and implementing the disaster loss database needs to be participatory and inclusive, involving all relevant actors, at all levels of government. Co-operation of all actors involved in the conceptual and methodological development, maintenance and use of disaster loss databases is crucial. This includes for example, universities and research centres, private companies, NGOs, government and regional and local agencies related to disaster response and risk management and other entities that facilitate the process. While such a multi-stakeholder process renders the process costly, it is absolutely essential for the gathering of reliable data and information in the long term. Italy represents a good practice where efforts to establish a national multi-hazard disaster loss database are already well underway and parallel to the technical aspects of developing the actual database, processes have been initiated to firmly embed the database into the institutional framework at all levels of government.

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185 http://effis.jrc.ec.europa.eu/.
186 http://floods.jrc.ec.europa.eu/efas-flood-forecasts.
187 www.gdacs.org.

Once established, continuous training and technical advice for all staff involved at government levels, as well as implementing partners, are crucial for effective and co-ordinated implementation. Inter-disciplinary personnel are preferable, as validation and analysis of data requires knowledge of several disciplines.

Further, it is also beneficial to advocate the importance of disaster loss databases by explaining the use and benefits of such databases for DRM planning and policy development, planning and programming. Finally, regular reviews and updates of the disaster loss database can benefit from clear links with "lessons learned" programmes MS are expected to develop following disasters.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for action are proposed:

- **Foster an enabling environment for the effective implementation and functioning of disaster loss databases.**

  This entails the following guidelines for action:
  - **Ensure clear ownership structures of the database and firm integration as a central tool for DRM.** Consultation of risk data and analysis could, for example, be mandated in national risk assessment methodologies or similar processes;
  - **Identify and commit counterpart agencies as well as human and financial resources at all levels of government.** The process of developing and implementing the disaster loss database needs to be participatory and inclusive, involving all relevant actors. In particular, the private sector with insurance and reinsurance companies offers a vast resource for additional data. Public-private partnership efforts, such as the development of PERILS and GDACS should be encouraged;
  - **Offer continuous training and technical advice for all staff involved at government levels, as well as implementing partners.** Inter-disciplinary personnel are preferable as validation and analysis of data requires knowledge of several disciplines;
  - **Promote the importance of disaster loss databases by explaining the use and benefits of such databases for DRM planning and policy development, planning and programming;**
  - **Encourage regular reviews and updates of the database with clear links to "lessons learned" programmes set up following disaster events.**

Supporting practices:

- DesInventar database
  For more information see: http://www.desinventar.org;
- Munich Re's NatCatService database
  For more information see: http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx;
- Swiss Re's sigma CatNET
  For more information see: www.swissre.com;
- CRED's Em-Dat database
  For more information see: http://www.cred.be;
- Pan-European Risk Insurance Linked Services (PERILS)
  For more information see: www.perils.org;
- Global Disaster Alert and Co-ordination System (GDACS)
  For more information see: www.gdacs.org;
- Implementation process for national multi-hazard database in Italy.

5.4.2 *Develop multi-hazard, multi-scale disaster loss databases that are context-specific for informing DRM in Europe*

The review of GPs has shown that an improvement in disaster loss information on the international and national levels is not sufficient. In particular, for translating the information into action for DRM, context-specific variables need to be added on a more local scale. This requires good co-operation of all actors involved across hazards, sectors, agencies and levels of government. While considerable progress has been made in generating and utilising such information on a national level in many countries, it is still not regular practice[188].

The multi-hazard character of disaster loss databases should be encouraged. It allows the database to provide the necessary data and analysis for risk assessments, hazard mapping and other activities for DRM. A multi-hazard approach is also in line with overall trends for DRM to be mainstreamed into other policy areas, due to its interlinks with many other fields, such as climate change adaptation.

Additionally, disaster loss databases need to account for large, as well as medium and small scale disasters. Often, thresholds for inclusion in the global loss databases, where only large and economically significant disasters are included, tend to bias the data toward single hazard events with large losses, rather than compounded small-scale events involving multiple hazards with fewer individual losses for each event[189]. However, as has been mentioned above such low-intensity events, when repeated frequently, can lead to large socio-economic losses particularly at the local context. For example, many of the so-called 'disasters' in the EM-DAT and especially the DesInventar databases, are not triggered by statistically extreme hazard events, but they rather exhibit extreme losses due to severe interruptions in the functioning of local social and economic systems.

In order to contribute meaningfully to the DRM process, the right scale and spatial resolution has to be determined when setting up a disaster loss database. While for some purposes data and information aggregated on a national scale are sufficient, other DRM purposes require the down-scaling of loss information to sub-national and localised risk information, in order to reach and be utilised by the target audience. Analyses on different scales of observation and levels of spatial resolution can provide the relevant elements for decision-makers to gain new insight into risk, including the importance of local context, recurrence of losses caused by low-intensity events within the same territory and thus processes of risk accumulation. Thus, databases need to incorporate the ability to adjust outputs based on various context-specific needs.

Without such possibilities for customisation regarding disaster scale, context and spatial resolution, databases could fail to deliver on their intended purpose. The actual usage of the database is absolutely crucial if it is to serve as a meaningful tool for informing DRM. To this end, locally customised manuals need to accompany the implementation of a disaster loss database, in order to ensure the target groups fully grasp the potential of using the data and analysis offered by the database.

The European expert meeting on hazard and disaster data[190], held at the EEA head office in Copenhagen 19-20 May 2010, concluded that while several global databases represent valuable information sources for hazards and impacts throughout Europe, these global databases were not

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188 Cardona, O.D., M.G. Ordaz, M.C. Marulanda, M.L. Carreno, and A.H. Barbat, 2010. Disaster risk from a macroeconomics perspective: a metric for fiscal vulnerability evaluation. Disasters, 34(4), 1064-1083.

189 GRIP, 2010. Establishing and Institutionalising Disaster Loss Databases in Latin America: Guidelines and Lessons.

190 http://forum.eionet.europa.eu/eionet-air-climate/library/public/workshops/disaster_19-20_2010.

specifically created for the EU nor the 32 EEA member countries, and as such feature some characteristics which limit their usefulness for European policy purposes. In particular, further geographical information, such as vector data, spatial resolution and GIS data is missing for sub-regional or local analysis in Europe. Similarly, thresholds for inclusion of an event are rather high for these global databases, while on a European level also smaller scale events and impacts should be covered. Furthermore, experts noted the need for improved definitions and terminology for economic losses and/or damage costs, as well as terms such as affected people. Finally, validation of country specific data would need to be accomplished via MS and data of global databases needs to become even more publicly accessible.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for action are proposed:

- **Develop multi-hazard, multi-scale disaster loss databases that are context-specific for informing DRM processes.**

  This includes the following guidelines for action:
  - **Ensure the inclusion of context-specific variables and resolutions for informing DRM at the local level;**
  - **Encourage a multi-hazard character for the disaster loss database.** A multi-disciplinary perspective will render the database a powerful tool for generating data and information needed for multi-hazard risk assessments, hazard mapping, etc.;
  - **Cover large, medium and small scale disaster events.** Particularly for the local context, a combination of many small scale events, when repeated frequently, can lead to large socio-economic losses;
  - **Ensure the ability to scale down loss information to sub-national and local levels for informing the DRM process**;
  - **Comprise adjustability across spatial resolution (regional, national, local) in order to cater to specific audiences and their context-specific needs for risk information;**
  - **Generate locally customised user manuals and trainings to accompany the implementation of the disaster loss database.** This ensures the target audience fully grasps the potential of using the data and information offered by the database.

Supporting practices:

- DesInventar database
  For more information see: http://www.desinventar.org;
- eMARS database
  For more information see: mahb.jrc.it;
- CRED's Em-Dat database
  For more information see: http://www.cred.be;
- Efforts towards establishing national multi-hazard loss databases using DesInventar Methodology – Italy, Croatia, Serbia and Albania.

5.4.3 *Work towards harmonising terminologies, input variables and methodologies for data collection, validation and analysis*

More attention is required to identify what type of information and content is really essential for these disaster loss databases to be able to adequately inform the various stages of DRM. This involves the development of common terminologies, input variables and methodologies for data collection, validation and analysis. Such definition of standards aids inter-operability and comparability of data.

Comparisons of international and national disaster loss databases have shown that what gets counted and documented as disaster losses varies between databases, due to inconsistencies in the definition of key parameters and estimation methodologies[191]. Currently, many different tools and formats to systematise information on disasters are in use. Consequently, there is still a lack of international consensus regarding GPs for collecting these data in a more standardised way. In the end it is crucial to understand why the data is being collected and what the end use of the data will be. With this knowledge it is possible to define the appropriate process and methodology to follow.

Differences in definitions and estimation methods not only render comparison across scales impossible, but they also lead to communication gaps between professional groups due to different language styles and jargon applied. Therefore, experts recommend establishing universally shared basic operational definitions of key terms such as risk, vulnerability, and adaptation across different sectors as a basis for the effective sharing of knowledge and information.

Regarding the harmonisation of terminology, already existing efforts should be followed as closely as possible. There is a need to continue standardisation efforts for the sake of improved comparability and increased transparency as well as reliability of data sets. EM-DAT and NatCatSERVICE are, for example, currently working on standards for geo-coding.[192] Experts also recommend establishing universally shared basic operational definitions of key terms such as risk, vulnerability, and adaptation across different sectors as a basis for the effective sharing of knowledge and information. The UNISDR's *Terminology on Disaster Risk Reduction*[193] published in 2009 and the International Organisation for Standardisation's (ISO) *Guide 73:2009 on Risk Management Vocabulary*[194] currently offer the most comprehensive and widely accepted definitions of the most common terms and jargon used in DRM. For the specific context of fostering greater comparability of data and for ensuring that risk information is interpreted correctly by the target audience, certain terms and concepts need particular attention.

Regarding the issue of terminology in Europe specifically, the European expert meeting on hazard and disaster data, held at the EEA head office in Copenhagen 19-20 May 2010, also emphasised the current problem of having various definitions for natural disasters and catastrophes for different types of hazards. In addition, these definitions are then applied differently in local, regional and global databases. Currently there are no internationally agreed and recognised minimum criteria for an event to be classified as a disaster which could then be applied in all existing and new databases.[195]

Next to harmonising basic terminology, it is also essential to define key variables (what type of information) to be taken into consideration when elaborating disaster loss databases in order to be able to use the database for effective DRM. While there are certainly hazard and context-specific information requirements, several cross-cutting information needs can be identified. These include accounting for a changing climate and how it affects risk variables, time series information on climate variables, such as air and sea surface temperatures, rainfall and precipitation, wind and air circulation patterns, as well as greenhouse gas levels is essential. Seasonal climate forecasts, as well as in situ measures of soil moisture, vegetation growth, rainfall-runoff, crop yields,

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191 IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

192 http://forum.eionet.europa.eu/eionet-air-climate/library/public/workshops/disaster_19-20_2010.

193 http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf.

194 ISO. ISO Guide 73:2009 Risk Management – Vocabulary.

195 http://forum.eionet.europa.eu/eionet-air-climate/library/public/workshops/disaster_19-20_2010.

epidemiology, all assist preparedness and planning. To contribute to hazard zoning, databases need to offer geo-referenced inventories of hazard occurrence and impacts at local, sub-national and national levels. Further, the geospatial distribution of human development indicators, such as poverty, livelihood sources, critical infrastructure, etc. is a prerequisite for calculating vulnerability levels. In addition, loss databases need to establish a system of risk indicators appropriate for macro factors such as economics, financial, social and environmental risks, human vulnerability conditions and strength of governance[196]. Further, the inclusion of national asset inventories, national population censuses and other similar national statistical information over the longest period of time possible provides important basic input information. Additionally, DRM requires the identification of social processes that contribute to vulnerability, such as economic and organisational capacities, to respond to disasters, as well as evaluating the impacts following a disaster event.

A final step towards greater comparability and interoperability of disaster loss databases is the data collection, validation and analysis process itself. Greater standardisation of methodologies can facilitate take-up and usage of the generated data and information and improve comparative research and assessment. Various methodologies already exist, such as DesInventar's Preliminary Analysis Methodology or EFFIS' damage assessment module. At the international level, the Disaster Loss Data Working Group of the Integrated Research on Disaster Risk (IRDR)[197], is studying issues related to the collection, storage, and dissemination of disaster loss data. The Working Group has identified several urgent needs: (a) for developing comparable and accessible disaster loss data to support research and policy and (b) for defining key terminology and creating of a common methodology for assessing losses. To work towards these actions, the Working Group intends to establish an overall framework for disaster loss data for all providers, establish nodes and networks for databases, conduct sensitivity testing among existing databases and create mechanisms for archiving loss data[198].

While it is too far-fetched at this point in time to propose one single methodological approach, it is important to underline that at the very least the data collection, validation and analysis process must follow a pre-determined structure and have cross-checks built into the system. Data records should be gathered from agreed and accepted sources and staff must receive training to understand disaster terminology, the intended use of the data. Exactly what procedure to follow when collecting the data should also be made clear. Additionally, duties need to be clearly divided, documentation must be clear and easy to understand and quality needs to be strictly assured during data validation processes.

The European expert meeting on hazard and disaster data[199], held at the EEA in Copenhagen 19-20 May 2010, reached conclusions in line with the above principles. First of all, more data should be collected at national and sub-national scale for various hazards and needs to be easily comparable to improve European disaster loss knowledge. To this end, further standardisation is needed, including methodology, terminology, definitions, etc., as well as formats for data collection and the analysis framework. At the same time, the minimum quality criteria for databases proposed at the European expert meeting also represent a solid basis for improvement actions. These are: transparency (sufficient and clear documentation), completeness (all relevant categories, all years and the entire country), consistency (regular updating), comparability (allowing comparisons

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196 Wilby, R.L., Troni, J., Biot, Y., Tedd, L., Hewitson, B.C., Smith, D.G. and Sutton, R.T. 2009. A review of climate risk information for adaptation and development planning. International Journal of Climatology, 29, 1193-1215.

197 http://www.irdrinternational.org/about-irdr/scientific-committee/working-group/disaster-loss-data/.

198 http://www.irdrinternational.org/about-irdr/scientific-committee/working-group/disaster-loss-data/.

199 http://forum.eionet.europa.eu/eionet-air-climate/library/public/workshops/disaster_19-20_2010.

between countries), accuracy, timeliness (compiled and made available according to an agreed time schedule), quality assurance and control procedures, sufficient financial backing and clear institutional arrangements to ensure a sustainable system (incl. clear roles and responsibilities), accessibility, and interoperability.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for action are proposed:

- **Establish universally shared basic operational definitions of key terms by adopting and cross-referencing the existing UNISDR and ISO risk terminology.** UNISDR's *Terminology on Disaster Risk Reduction* published in 2009 and ISO's *Guide 73:2009 on Risk Management Vocabulary* offer the most comprehensive and widely accepted definitions of the most common terms. In addition, **urge further harmonisation of key terminology particularly relevant for disaster loss databases, namely:** (a) definition of a 'disaster' / 'catastrophe' (establish internationally agreed and recognised minimum criteria for an event to be classified as a disaster); definition of a 'loss'; differentiation between 'insured loss' and 'uninsured loss'; 'direct' versus 'indirect' losses; 'economic' versus 'social' versus 'environmental' losses; 'total loss' (loss-only versus loss/gain calculations); definition of fatalities (what is a 'dead' versus a 'missing' person versus an 'injured' person, and what is 'total affected' people). **At the very least, make sure that databases clearly and visibly define what is considered a disaster 'loss' in their database;**
- **Follow the minimum quality criteria for databases in Europe proposed at the European expert meeting under the EEA umbrella.** These are: transparency (sufficient and clear documentation), completeness (all relevant categories, all years and the entire country), consistency (regular updating), comparability (allowing comparisons between countries), accuracy, timeliness (compiled and made available according to an agreed time schedule), quality assurance and control procedures, sufficient financial backing and clear institutional arrangements to ensure a sustainable system (incl. clear roles and responsibilities), accessibility, and interoperability;
- **Develop a list of key basic indicators / input variables to be taken into consideration when elaborating disaster loss databases.** These could include for instance: geo-referenced inventories of hazard occurrence and impacts across scales; national asset inventories; national population census; geospatial distribution of human development indicators; climate variables; seasonal weather forecasts; several in situ measures, such as vegetation growth and crop yields; indicators reflecting macro-economic, financial, social and environmental risks; human vulnerability conditions; and quality of governance. All of these basic parameters should be provided for the longest period of time possible;
- **Encourage common prerequisites for methodologies for data collection, validation and analysis**. While a single methodological approach may not be feasible, disaster loss databases should be in line with ongoing efforts for standardisation at European (i.e. INSPIRE Directive defining requirements for establishing infrastructure for spatial information in Europe; linking with operational GMES services 'land' and 'emergency response'; applying the SEIS (Shared Environmental Information System) principles) and international level (e.g. efforts carried out by the Disaster Loss Data Working Group of the IRDR) and follow certain basic prerequisites, including: setting up and following a pre-determined structure; definition of standards for both inter-operability and comparability of data, build in cross-checks into the system for greater robustness; accept data only from agreed and reputable sources; set up clear division of duties; draft clear documentation; train staff to understand terminology and intended use of data and data collection procedure and implement quality assurance system for data validation;
- **Support the development of national multi-hazard disaster loss databases along the lines of the DesInventar Methodology.** Such process has been started within several countries throughout Europe and should be encouraged for other interested MS.

Supporting practices:

- European Forest Fire Information System
  For more information see: http://effis.jrc.ec.europa.eu;
- Disaster Loss Data Working Group of the IRDR (Integrated Research on Disaster Risk)
  For more information see: http://www.irdrinternational.org/about-irdr/scientific-committee/working-group/disaster-loss-data/;
- eMARS database
  For more information see: mahb.jrc.it;
- UNISDR 2009 Terminology on Disaster Risk Reduction
  For more information see: http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf;
- ISO Guide 73:2009
  For more information see: available for purchase from ISO;
- DesInventar database
  For more information see: http://www.desinventar.org;
- Recommendations from the European expert meeting on hazard and disaster data, May 2010
  For more information see: http://forum.eionet.europa.eu/eionet-air-climate/library/public/workshops/disaster_19-20_2010.

5.4.4 *Utilise ICT for facilitating international exchange and dissemination of the disaster loss data and information*

ICT systems are major tools in facilitating the necessary international exchange and dissemination of the disaster loss data and information. As in most other fields, the use of ICTs such as digital libraries, computer networks, satellite communications, GIS, remote sensing, grid technology, etc. has become the preferred means for data and information integration for knowledge acquisition and sharing. ICT offers advantages such as interactive modes, communication across distances, and universal accessibility for online data sharing and retrieval.

ICT should also foster further integration of DRM considerations into other policy processes, such as climate change adaptation and wider sustainable development efforts. ICT innovations will help increase effectiveness of data gathering and increase resolution, while reducing costs.

On a regional scale, for example, the EFFIS demonstrates the advantages of setting up disaster loss databases that communicate information via integrated ICT structures. EFFIS consists of a scientific and technical infrastructure at the JRC and operates a web-based system. The online web-based system is supported and maintained via an extensive EU fire database. During the main fire season (June to September), in addition to sharing information on the website, daily emails to forest services and civil protection services of the EU ensure that maps of forecasted fire danger reach the relevant national and local actors responsible for prevention measures.

Based on the abovementioned basic principles and evidence from good practices, the following guidelines for action are proposed:

- **Utilise ICT for facilitating international exchange and dissemination of the disaster loss data and information.** ICT represents an ideal platform for sharing lessons learned worldwide as it can be accessed from any location (providing there is internet access). Data and information can be shared via interactive interfaces in real-time, without unnecessary delays;
- **Ensure an ICT system that is user-friendly and globally accessible online, for data sharing and retrieval.** The ICT system needs to be sufficiency robust so as to not collapse when it is most accessed and needed by disaster managers. The interface needs to be designed in a user-friendly way that is rather self-explanatory and does not require extensive user training. Furthermore, access

not only to analysed data, but also raw data needs to be enabled for certain stakeholders. This is to ensure maximum usability of the database for informing the policy-making process and decisions for DRM.

Supporting practices:

- UNISDR PreventionWeb Facility

  For more information see: www.preventionweb.net;

- European Forest Fire Information System

  For more information see: http://effis.jrc.ec.europa.eu;

- DesInventar database

  For more information see: http://www.desinventar.org;

- *ARIA database*

  For more information see: http://www.aria.developpement-durable.gouv.fr.

5.5 Guideline: Secure greater uptake of science in policy-making, planning and implementation of DRM

Science, knowledge and research play an essential role in securing effective DRM. This role is emphasised in several sections of the HFA and is confirmed by the set-up of the UNISDR Scientific and Technical Committee (STC) in 2008. To ensure that science and research reaches "beyond the ivory tower" however, there needs to be an active and sustained collaboration and dialogue within the scientific community across disciplines, as well as between scientists and policy makers, planners, and other relevant stakeholders.

Top-down integration of science via international, national and regional agencies has, up until now, been a natural way to approach the science-policy interface. Agency staff liaise with technical experts in universities and institutes, and engage in the exchange of expertise, experience and resources to promote learning and improvements of policy measures to mirror scientific advances. The emergence of non-governmental actors in risk management such as volunteers, businesses, NGOs and educators, however, opens up for new governance approaches that require more participative processes. These developments require science to also be integrated from bottom-up, e.g. an NGO also needs to base its actions on sound science. Finally, there is increased understanding that risk management is an interdisciplinary science that demands co-operation and learning within and between sub-disciplines in the technical, natural sciences and the social sciences.

5.5.1 Ensure the use of science in planning by integrating risk assessment tools and EWS

Identifying, assessing and planning for disaster have already been addressed in this report but they are recurring themes in good DRM. From a top-down science-policy interface perspective, it is clear that planners and scientists need to engage in dialogue to improve the use of data and research in planning. It is strengthened by the observation that decision-makers manage risk holistically, whereas scientists generally use specific, more reductionist methods[200]. Misunderstandings and distrust between scientists and decision-makers are likely to increase transaction costs, lead to

[200] IPCC, 2012. Summary for Policymakers In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 3-21.

delays and a sub-optimal DRM process[201]. To overcome this obstacle, research should be user-driven, aligning practical needs with research agendas and allow for two-way communication and collaboration between decision-makers and scientists to create an environment of trust and understanding[202].

More practically, science and research on, for example, seismic hazards such as micro-zoning, needs to be connected to an EWS that is efficient and comprehensive, and use the appropriate communication tools to reach as many people as possible. In general, EWS requires multi-disciplinary and multi-stakeholder approaches to be effective, and national agencies can play an important role in co-ordinating action, setting high-level objectives and promote community-based mechanisms[203]. Moreover, science and research are incorporated in every part of the chain and should be integrated together with the decision-makers at the different policy stages. Several aspects have been elaborated upon in earlier parts of the report, but the following practices and policy-tools are inter alia integral to science-policy integration[204]:

Practices:
- education and awareness raising;
- integration of participative approaches;
- calculating costs of disaster losses;
- involvement of businesses and civil society organisations.

Policy tools:
- EWS;
- building codes (Eurocode 8);
- hazard mapping and micro-zoning.

Creating an emerging understanding within climate change adaptation, among other fields, is the role of adaptive management, which emphasises the necessary linkages between interdisciplinary, experience and traditional knowledge on the one hand; and decision-making processes, learning organisations and individuals on the other[205]. It requires scientists to work across disciplines and communicate with decision-makers on their results. However, it also necessitates learning mechanisms between scientists and practitioners, an aspect that is currently underdeveloped.

- Planners and scientists need to engage in dialogue to improve the use of data and research in planning;
- Research should be user-driven, aligning practical needs with research agendas and allow for two-way communication and collaboration between decision-makers and scientists to create an environment of trust and understanding;
- With regard to the development of EWS, it requires multi-disciplinary and multi-stakeholder approaches to be effective. National agencies that co-ordinate action, set high-level objectives and promote community-based mechanisms should also draw upon the latest research and carry out active dialogue with scientists.

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201 Ibid.

202 Ibid.

203 Ibid.

204 Based partly on: ICSU, 2008. Science plan on hazards and disasters: Earthquakes, floods and landslides. International Council for Science (ICSU).

205 IPCC, 2012. Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 3-21.

Supporting practices:

- UK Foresight Programme;
- FP7 funded MATRIX project (New Multi-Hazard and Multi-Risk Assessment Methods for Europe);
- Integration of early warning into flood risk management (FL49, FL51, FL35);
- Forest fire early warning systems in Germany (FF10) and Italy (FF13);
- METEOALARM project for heatwaves (HW4);
- NEAREST EWS prototype (integrated observations from near shore sources of tsunamis: towards an early warning system).

5.5.2 *Promote bottom-up approaches in putting research into practice*

Planners and decisions-makers are generally the first contact with whom scientists engage. However, the emergence of new governance, where non-state actors such as civil society organisations, businesses and volunteers take up a bigger role in DRM, requires scientists and researchers to broaden their target groups and adapt to more participative approaches. In some cases bottom-up knowledge transfer happens naturally. Business, for example, has increased their use of weather and climate information to factor in hazards and climate in their risk management[206]. Overall these bonds need to be created, fuelled, and sustained.

- Ensure that the results of research reach the end-users, particularly those outside the administrative and political structure;
- Distribute research findings for use by the private sector;
- Invite experts and practitioners at local level to test methods and tools developed through research;
- Invite decision-makers, different stakeholders and private actors to formulate research ideas based on their needs. Participatory methods are essential to make research more usable. It is important to involve stakeholders from the start in different research projects.

5.5.3 *Engage scientists in interdisciplinary research and dialogue*

Related to the use of science in planning is the often missing link between natural and social sciences. To fully integrate hazard exposure and social vulnerability in comprehensive vulnerability assessments, for example, one needs to engage natural scientists in providing data, models and methods for exposure assessments and the social scientists, to identify vulnerable groups and the population at risk[207]. Current research on disaster risks and hazards is heavily populated by natural scientists. The social sciences account for only a small share of research funding and are often seen as “ad hoc” to the more foundational technical scientific inquiry. One author notes that there are approximately as many social scientists working on disaster risks and hazards as there are volcanologists[208].

The bifurcation of “hard”, “natural” and “soft” social sciences can take place already in schools and universities. While there is already an increasing trend to assist students with understanding both sides of the coin, this could be improved. There is often an artificial divide between the sciences and school curricula, and university courses should consider methods for integrating the two[209].

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206 Changnon, D. and S.A. Changnon, 2010. Major growth in some business related uses of climate information. Journal of Applied Meteorology and Climatology, 49, 325-331.

207 Ibid.

208 Committee on Disaster Research in Social Sciences, 2006. Facing hazards and disasters: Understanding human dimensions. National Academic Press.

209 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: Ljubljana (available at: http://caphaz-net.org/outcomes-results/CapHaz-Net_WP6_Risk-Education).

Based on the abovementioned basic principles and evidence from GP, the following guidelines for action are proposed:

- **Encourage technical and social scientific research on natural hazards and their predictability, as well as on possible ways by which to mitigate the impact of both natural and industrial disasters on the populations.** The development of any new disaster mitigation measure requires progress in three phases. First is a research phase. This should be followed by a test bed phase, where scientific results are compared in terms of their quality and consistency, followed lastly by an implementation phase that includes verification of practical uses of scientific achievements. Clearly, any practical use of scientific methods must be done in an appropriate policy framework, which should balance costs against benefits and potential gains against possible risks;
- **Determine how scientific results may be provided to decision-makers in a useful way.** This should be done by working groups, with representatives of relevant agencies, and social scientists, as well as science experts in the specific subjects of the research, reporting to the scientific advisory structure;
- **Encourage work across disciplines both within and between the social and natural sciences**. It has become clear that disaster risk governance is a trans-disciplinary field of research. Technical and natural sciences are central in assessing risk levels, designing resilient houses and infrastructure, and developing sensory techniques; while social sciences investigate how to transform knowledge into behavioural change, how to design governance frameworks and how to create resilient communities. Economics also has a major contribution to make for example in the areas of cost-benefit analysis, data and financing;
- **Support bottom-up use of scientific information.** New governance structures that engage a range of non-governmental actors in risk management require new approaches to delivering effective DRM based on sound science. It is essential that NGOs, volunteers and companies, for example, be provided with easily accessible and user-friendly science that helps them carry out DRM tasks.

Supporting practices:

- EMSC-SCEM European-Mediterranean Seismological Centre (EMSC).

See more: http://www.emsc-csem.org/about/.

Annex A – Inventories of Good Practices

This document contains the deliverable of an inventory of good practice in disaster prevention in Europe for the study on "Strengthening the EU disaster management capacity – Good Practices on Disaster Prevention" (ENV.A.4/SER/2010/0004) carried out for DG ECHO by a consortium led by Ecorys.
The inventory is a non-exhaustive list of good practices collected from all European countries and selected non-European countries. It is divided into themes which corresponds to the tabs found in this document.

This document is available in a separate file: Annex A - Inventories of Good Practices.

Annex B – Interview Summary Report

The interview summary report provided as separate file.

Annex C – Workshop Report

The workshop report is provided as separate file.

Annex D – Overview PowerPoint Presentations

The overview of the PowerPoint presentations is provided as a separate file.

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