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Dipartimento della Protezione Civile

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Associação para o Desenvolvimento da Aerodinâmica Industrial

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ROADMAP2

Using Foresight Techniques in Longer-term Disaster Risk Management

FLASH REPORT 1

Using Foresight Techniques in Longer-term Disaster Risk Management

Lead Authors
Kati Orru, Ingeliis Siimsen, Sten Hansson

Contributing Authors
Daniela Di Bucci, Claudia Morsut

Graphic design
Giulia Fagà, Gabriele Ferro

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1. Introduction

In the context of the complex nature of modern disasters, anticipating and preparing for emerging risks requires a comprehensive risk assessment involving foresight techniques (Girgin et al., 2019; Jahangiri et al., 2017). It is necessary to move beyond past-oriented paradigms and conceptualise disaster risk as a dynamic system (Riddell et al., 2020). Foreseeing the plausible futures based on emerging trends enable communities most at risk to shape their risk-informed development plans accordingly. Unlike traditional planning methods and tools, foresight methods embrace uncertainty and consider a range of future possibilities and new solutions.

Foresight practices include horizon-scanning for identifying key drivers of change and the hazards and opportunities in the medium and long-term, e.g., years 2040 and 2070 (Jahangiri et al., 2017), and long-term scenario-building and scenario-based assessments for analysing impacts of different future conditions of disasters. Often setting the foundations for scenario-building, foresight techniques such as horizon-scanning allow for early identification of current and new risks and challenges and support the undertaking of adaptive, preventative or preparedness action for impending disruptive events.

European Union Disaster Resilience Goals (EUDRG; European Commission, 2023) foresee that these methodologies should be applied more systematically in disaster risk management (DRM). Goal 1 emphasises the need to improve the EU and member states' capability in risk assessment, anticipation, and disaster risk management planning in complex disaster risks. DRM actors should turn the assessment of future risks into information that can trigger early action, further improve the scenario-building capability, the assessment of risk itself, the anticipatory capability and the risk management planning, with a view to developing preventative action.

The regulatory frameworks for conducting foresight analysis in the DRM context are under-developed, though. Sendai Framework for Disaster Risk Reduction 2015-2030 encourages signatory countries to analyse potential futures in DRM. In the European Union, national risk assessments are prepared by Member States in compliance with Decision 1313/2013/EU; Member states should conduct risk assessments as an overall cross-sectoral process of risk identification, risk analysis, and risk evaluation undertaken at national or appropriate sub-national level. More specifically, the risk assessment focuses on potential threat scenarios and disruptions that may occur in the future (European Parliament, 2012). Thus, Member States are to determine how multiple drivers of longer-term futures are taken into consideration in risk analyses.

So far, there is no systematic overview of the civil protection authorities' practices in using foresight techniques to overcome the uncertainty and complexity of factors determining the outcome of future disasters. This ROADMAP2 project flash report explores how are foresight techniques used in risk assessments to guide adaptive, preventive, or preparedness actions in the civil protection system. The aim of this flash report is to provide an overview of foresight analysis practices by DRM authorities in different countries. We seek answers to the following questions:

1. What has been the purpose of applying foresight in DRM?
2. What types of risks, which trends or subject projections are addressed?
3. Which time horizons and methods are used in foresight analysis?
4. What are the success factors for strategic foresight in DRM?

The report follows the methodology for identifying and assessing good practices in DRM set forth in the ROADMAP2 deliverable D3.1. In this context, good practices are defined as activities that substantially reduce disaster risk and losses in lives, livelihoods, health, and assets.

Disaster management planning, risk assessments and scenario-building were considered as the key areas of relevance in the search for good practices in DRM. Firstly, the search for good practices was conducted across academic databases using search terms such as "disaster", "crisis", "future" and "foresight". The databases used for the search were Web of Science, ScienceDirect and Google Scholar. Secondly, a search for foresight practices was conducted across the websites of international organisations operating in the field of DRM, including UNDRR, WHO and GNDR. Additionally, the search for foresight practices at a national or a subnational level was conducted using Google search engine. This search yielded mainly national risk assessment reports and mid-term reviews for the Sendai Framework of Disaster Risk Reduction.

In identifying good practices amongst the results, the identification criteria set in ROADMAP2 (2023) deliverable D3.1 Framework for identifying and assessing GPs in DRM were applied:

- cover the DRM cycle (e.g., have been realised in prevention, preparedness, response and/or recovery phases);
- adhere to priorities and targets of the Sendai Framework for DRR;
- adhere to the UDRGs;
- consider a multi-risk perspective;
- through research and/or practice, have been applied and work in a real context in achieving outcomes and results (evidence);
- involve different types of stakeholders (international, national, local, but also different professions).

To gather reflections regarding the success factors for strategic foresight in DRM, a ROADMAP2 webinar was organised in January 2024. The webinar hosted

a panel of three expert speakers: Laurent Bontoux (Senior Foresight for Policy Expert at European Commission Joint Research Centre), Simone Kimpeler (Head of the Competence Center Foresight at Fraunhofer ISI), and Jussi Korhonen (Director of Civil Emergency Preparedness for Finnish Ministry of the Interior), moderated by Kati Orru (University of Tartu, Risk & Resilience Research Group). The webinar was open for public participation; altogether, there were 351 participants.

2. Frameworks for analysis of futures in disaster risk management

Disaster risks are complex interactions between three key elements: the hazardous events and their probability of occurrence, the exposure of people, buildings, infrastructure and the environment in the affected area to the considered hazards, and their vulnerability to the hazardous events (Global Facility for Disaster Reduction and Recovery, 2016). Each of these elements is also continuously in flux as changing environmental threats and societal developments and decisions uniquely combine in risky events, making them complex and uncertain (Cutter, 2013).
Foresight analyses often involve prioritising future risks. Recent expert assessments (AXA, 2023) highlight risks associated with global warming, geopolitical instability, cybersecurity, artificial intelligence, and big data.

2.1 Considering drivers of change in long time horizons

Disaster risk assessments need to be accompanied by understanding features and drivers that can have an impact in the long-term (Riddell et al., 2020). Foresight draws attention on drivers of change, such as globalisation, urbanisation, technological development, and changing value systems. For example, population growth, an increasingly ageing population, and rapid urbanisation can bring about many challenges, leading to numerous public health concerns (e.g., the spread of infectious diseases) and conflicts in densely populated areas (World Health Organisation, 2022). In other domains, for example, increasingly sophisticated communication technology may exacerbate the spread of mis- and disinformation that complicates DRM (Hansson et al., 2021; Torpan et al., 2021).
While traditional strategic planning often focuses on the next few years, in strategic foresight, the much longer time horizon of 10 or more years is meant to help explore novel possibilities and alternatives to expected futures (UNDP, 2022), think as broadly as possible about the changes that are impacting a domain, and challenge assumptions that surround dominant views of the future.

2.2 Process of strategic foresight in disaster risk management

In disaster context, foresight allows for transparent consideration of driving forces impacting on disaster risk, and the system of values in a region undergoing a risk assessment (Riddell et al., 2020). Defining the possible future context within risk assessment enriches the planning and risk treatment process. Riddell et al. (2020) distinguish three key components of the foresight approach:

- Risk foresight: identifying the key drivers that impact the risk system, describing objectives and indicators of impact, and identifying future conditions for testing risk treatment effectiveness.
- Dynamic risk assessment – linkages from identified drivers to assessment components; interaction between factors and the emergence of risk; ability to incorporate current decisions and their impact on future risks.
- Risk treatment – explicitly considering residual and emergent risks; treatments impact across exposure, hazard and vulnerability factors and clearly align with identified drivers of risk; impact of treatments has been considered within the system of risk and potential unintended consequences identified.

One of the key features of the strategic foresight process is the inclusion of an expanded range of perspectives and strategic options to be considered in a planning process (Voros, 2003) to improve the understanding of the implications of various trends in society (Inayatullah, 2018). Strategic foresight promotes stakeholder participation and mediation in debating and shaping plausible and desirable futures collaboratively (Rosa et al., 2021). Participatory methods increase the reflexivity of innovation systems that invest the needed time and resources into exploring the depth of multi-actor nterests and intersections.

2.3 Techniques of foresight

Multiple techniques can be used to gather insight into the impact of drivers and future developments on risk in a foresight process. Such techniques generally involve scanning current trends and assessing possible future directions as a participatory process. Other methods take a more quantitative approach and exploit existing modelling systems to determine hazards, vulnerabilities and exposure.
A common approach used in foresight studies is the **development of scenarios** (also known as scenario-building) and the integration of these scenarios into planning processes. Scenario studies portray future plausible states, and pathways that led to their development. The scenarios as stories or images of the potential future help to explore their potential implications (Kelly, 2020). Scenario-building may include the 'probabilistic modification of extrapolated trends' and the construction of scenarios as 'hypothetical sequences of events constructed to focus on causal processes and decision points' (Kahn & Wie-

ner, 1967). They allow discussion of the interaction of various factors and the role of 'discontinuities' and 'non-linear events' not captured in trends.
Other foresight mechanisms that provide value in considering tomorrow's disasters include the use of mega-trends, Delphi studies and exploratory modelling approaches. **The mega-trend analysis** involves analysing large-scale changes in the present, which have a complex and multidimensional impact on the future and affect multiple policy domains. **Horizon scanning** is 'looking for early warning signs of change in the policy and strategy environment. It aims to identify emerging trends, explore how they may develop and combine, and to consider their potential future impacts' (UK Government Office for Science, 2017).
In the following sections, we will outline some foresight practices as identified from existing literature. We will focus on the goals of strategic foresight processes, the risks and drivers considered in the long term, and the techniques and follow-up activities to support the achievement of these goals.

3. Practices of foresight in disaster risk management

3.1 Tasmanian heatwave case

Riddell and colleagues recently conducted one of the most systematic foresight exercises encompassing various risk drivers related to heatwaves in Tasmania. Riddell et al. (2020) introduce principles for applying strategic foresight in the Tasmanian risk assessment and use a time horizon of 30 years (up to 2050) (TASDRA, 2022).
Future scenarios are analysed across **five risk drivers (trends)**: population, demographics and associated vulnerabilities; community risk understanding and perception; economic development; urbanisation; climate change and following response. Potential scenarios are developed for each risk driver: the best-case, most likely and worst-case scenarios.
For a more in-depth analysis, best-case, most-likely and worst-case scenarios for a **heatwave in Tasmania** are developed and analysed across different consequence sectors: economic general, economic industry, environment species, environment value, people deaths, people injuries, public administration, social community well-being, social-cultural significance.

Process: Government representatives were engaged through workshops and semi-structured interviews to develop alternative scenarios for future disaster risk. Following the creation of future scenarios (foresight section), convenors conducted a dynamic risk assessment by integrating the foresight results into the official risk assessment (from 2016). In the process of dynamic risk assessment, 1) risk drivers identified in the foresight section were incorporated as assessment components, 2) interactions between different factors, and how feedback between them causes emergent risk, were analysed, and 3) the impact of current decisions on future risks was analysed.

Follow-up risk-reduction activities: Based on the dynamic risk assessment, risk reduction methods are proposed for both existing and emergent aspects of disaster risk.

3.2 Imagining the future of pandemics

The aim of WHO's foresight analysis (2022) is to support informed decision-making for leaders on the transition from emergency response to future preparedness for pandemics and epidemics and to ensure that we are globally better prepared to tackle them in the future.
WHO has applied a short time horizon – next 3 to 5 years – to encourage immediate action.

The trends considered are divided into five categories:

1. Social – the rise of intersectional inequalities and vulnerabilities; growing and ageing population; continuing urbanisation and densification; new ways of working; shift in information and communication patterns.
2. Technological – developments in artificial intelligence and machine learning; innovations in nanobiotechnology and health care; logistics and supply chain digitisation; data and intellectual property; digital interfaces.
3. Economic – economic migration; trade and local economies; the role of the private sector in humanitarian aid and health crises; mobility and travel, shifts in global power.
4. Environmental – biodiversity loss; resource depletion and sustainable energy; climate change resilience and net zero; food and water security; circular economy.
5. Political – deglobalisation; governance models; breakdown of trust in institutions; rise in power of independent actors; data privacy and cyber security risks.

Foresight process: Central to the foresight analysis was scenario building – the development of hypothetical, yet plausible, future scenarios, which can be subdivided into the following core stages. First, the critical determinants of the pandemic and other infectious threats were identified, and 25 high-impact trends were determined that would shape the future of the pandemic and other infectious threats. Then, the critical determinants of the pandemic and other infectious threats were split into three categories. This was followed by the analysis of the key components of the system and reviewing the trends and projections, resulting in an initial set of key factors across the three categories of the critical determinants of pandemic and other infectious threats.

These factors were later validated during workshops with stakeholders and experts. Thereafter, plausible, mutually exclusive projections for each key factor were identified. As a result of combining key factors and associated projections and producing consistent combinations of projections, four alternative scenarios were developed. Public roundtables were organised to discuss and explore implications and recommendations for these scenarios.

Follow-up risk reduction activities: The next steps include exercises at local, regional, and national levels and testing of the key assumptions in specific regions.

3.3 National Risk Assessment in Finland

In some countries, national risk assessments have included a more thorough analysis of future trends as potential drivers of future risk scenarios.

The aim of Finland's national risk assessment (Ministry of the Interior of Finland, 2023) is to anticipate relatively sudden incidents that call for activities deviating from the norm from either the local authorities or even requesting help from other countries. To do that, Finland's national risk assessment identifies risks with a wide national impact and assesses their potential impacts on society's vital functions.

15 threat scenarios and disruptions that can be divided into global, societal, and individual categories are analysed (Figure 1). These include disruptions in health security, the continuity of transport or food supply, and information influence activities.

The following key developments and broad overarching change phenomena and their projections are considered:

- Transformation of Finland's foreign and security policy environment, including the tensions and security concerns in the Baltic Sea Region brought up by the Russian-Ukrainian conflict, Finland's application for membership of NATO, global conflicts and challenges for EU's unity;
- Global value and supply chains involving the instability of international markets and disruptions in global markets and value chains as a result of cascading crises;
- Changes in society, which encompass trends such as polarisation, unequal distribution of wealth, spread of misinformation, evolution of criminal activity, maintenance of people's trust in public administration, ageing and urbanisation;
- An increasingly digital society revolving around the importance of cyber security and the increase of cyber-attacks, cybercrimes, availability of public information and cyber intelligence;
- Hybrid influence activities involving the intertwining of external and internal security in hybrid threats, which include, for example, political, diplomatic, economic and military methods as well as information and cyber influence activities;
- Three types of threats climate change that can bring about: regional risks related to extreme weather phenomena change, cross-border impacts, and transition risks related to climate change mitigation policies.

Foresight process: Impact assessment of threat scenarios and disruptions was applied. The trends are assessed in relation to the vital functions of society and the strategic tasks that safeguard them. These functions and tasks include psychological resilience, functional capacity of the population and services, internal security, defence capability, international and EU activities, leadership as well as economy, infra-

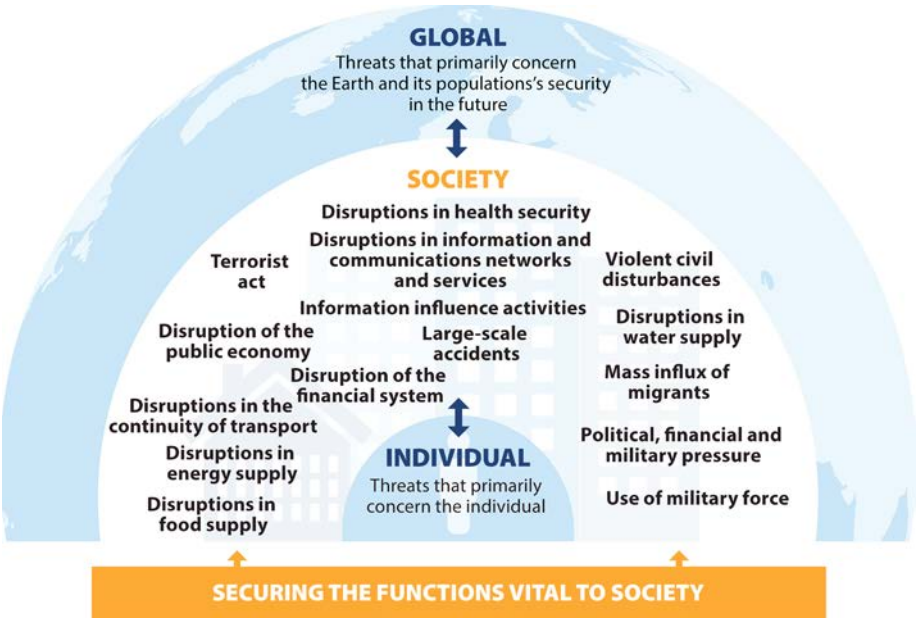

Figure 1: Finland's National Risk Assessment. Categories of threat scenarios and disruptions (Source: Finland Ministry of the Interior, 2023).

structure and security of supply. The impacts across these functions and tasks are assessed on a 4-point scale: no impact (-), minor (*), significant (**), severely compromising (***) (Figure 2). During the risk assessment of each scenario, the underlying threat(s), the target of the threat, the method of implementation (if possible) and the concatenation and cascading of impacts and disruptions were also identified.
Before assessing specific threat and disruption scenarios, the operating environment and its projected change was described as well. These descriptions are based on government reports on changes in the security environment and internal security. In Finland's previous Security Strategy for Society (Turvallissuuskomitea, 2017), the national risk assessment also served as risk analysis. After publishing this risk assessment, the updated Security Strategy for Society will be published in 2024.

3.4 National Risk Assessment in Belgium

The Belgian National Risk Assessment (NCCN, 2023) contributes to the Midterm Review of the Sendai Framework for Disaster Risk Reduction. The report aims to give an overview of already existing practices for disaster risk reduction in Belgium and provide insight into some future perspectives.
The emerging risk issues and societal trends (other than health and climate) that could affect different risk scenarios are mostly related to the developments in technology. These include 5G, Artificial intelligence, Energy transition, Systemic interdependence, Blockchain technology and cryptocurrency, Internet of Things related hazards, Quantum computing, Biohacking, Polarisation of society, Erosion of privacy.
In the risk assessment 2018-2023, 32 risks across four categories – natural, technological, health and security – were assessed. For example, risk scenarios included epidemics, animal diseases, nuclear accidents, telecommunication failures, cybercrime, terrorism and extremism, flooding, heatwaves, etc.

Process: The coordinator for crisis preparedness and management at the national level, the National Crisis Centre, contacted relevant external stakeholders to gather information regarding existing practices and lessons learned from past experiences. All relevant information the Crisis Centre had at hand, together with the input gathered from stakeholders, was compiled into a report following the structure of a questionnaire.

Follow-up risk reduction activities: They are reported in the National Adaptation Strategy, which describes the main climate change impacts, the existing adaptation responses, a roadmap to a future National Adaptation Plan and policy guidelines for further developments.

3.5 Canada's National Risk Profile

Canada's National Risk Profile aims to help reduce disaster risk and increase resilience for everyone in Canada. To be more specific, it aims to broaden the awareness of disaster risk, identify gaps in the Canadian emergency management system and provide evidence to support existing federal risk assessment and climate change adaptation efforts. It analyses the costliest hazards for Canada by developing scenarios to better understand their potential impact as well as the emergency management capabilities available to prepare for, respond to, and recover from these events. The risk profile report does not specify a specific time horizon, but Canada's Emergency Management Strategy covers the years up to 2030.

Figure 2: Example of the impact assessment of a threat scenario or a disruption (Source: Ministry of the Interior, 2023).

Range or drivers (trends) addressed: The Risk Profile considers risk drivers, e.g. processes or conditions that increase the magnitude of disaster risk by increasing the level of likelihood, exposure and vulnerability or by reducing management capacity. The critical risk drivers considered in the analysis include climate change, increasing population density and projected evolving demographics (e.g., household income, remoteness, access to essential emergency services, food security and age). Moreover, against the backdrop of the recent COVID-19 outbreak, pandemics are examined in a separate chapter as a contextual factor that affects disaster risk and response.

Type of risks analysed: The Risk Profile focuses mostly on natural hazards. Specifically, three of the costliest hazards Canadians face are analysed – earthquakes, wildland fire, and floods.

The foresight analysis consisted of two main parts – risk assessment and capability assessment – and involved inclusion of stakeholders from federal departments and agencies, provinces and territories, municipalities, indigenous organisations and communities, as well as the academic, private, volunteer, and non-governmental sectors, selected from across different communities living within Canada.

For the risk assessment, an all-hazards approach was applied, and a scenario-based risk assessment was carried out to evaluate the impact of scenario events using five standardised categories:

- People: (fatalities, injuries and psychological illnesses).
- Economy: (direct and indirect economic losses).
- Environment: (greenhouse gas emissions and all forms of environmental damage, e.g., to air, water, species, and environmental stock).
- Government: (damage to reputation, influence and/or ability to govern).
- Social Function: (disruptions to societal functions and displacement of individuals).

The scenario development process considered the following components:

- Sizing and Scaling.
- Plausibility Analysis.
- Expert Review.
- Historical Analysis.
- Representative Locations.
- Cross Validation and Refinement.

In addition to the risk assessment, a capability assessment was also carried out for each scenario. The capability-based planning approach aims to ensure a focus on the capacity and competence of personnel, tools, assets, and structures that compose the emergency management system in Canada. Additionally, it supports an evidence-informed process for reducing risk and building resilience and provides a structure to trace progress over time.

The capacities and competences of each capability were assessed through the lens of:

- people and organization – i.e., the human resource component, proficiencies, and surpluses such as staffing levels, knowledge, skills, and attribute sets. This includes education, qualifications, experience, training, organizational structure, and descriptions of roles and responsibilities;
- policies, processes, and practices – i.e., the policies, procedures, and practices component including activity criteria (thresholds and triggers) and sequencing, information flows, distribution of authority, decision structures, governance, and tasking;
- infrastructure, technology, and tools – i.e., the supporting assets and knowledge provision (data, information, and intelligence) required to deliver a capability.

Follow-up risk reduction activities: The second round of risk and capability assessments to broaden the National Risk Profile began in the fall of 2022. The second round examines three further hazards: extreme heat events, hurricanes, and space weather events.

Moreover, for each hazard examined in the risk profile, the future activities to mitigate the risks and build resilience are described.

4. Reflections on using foresight in disaster risk management

To gain more insight on success factors of using strategic foresight in DRM, we collected reflections during the ROADMAP2 webinar in January 2024, with expert speakers from European Commission Joint Research Centre, Center Foresight at Fraunhofer ISI, and Finnish Ministry of the Interior. The ideas and experiences shared during the webinar and some key messages from the literature review can be summarised as follows.

- The foresight process allows for a structured consideration of drivers and factors within a risk system and decreases the likelihood of unintended consequences. The webinar participants emphasised that the skilful design of a foresight process should prioritise creating a safe space for dangerous conversations, as risk and foresight often involve people's fears and worries. For example, workshops and game-style tasks are suitable formats for conducting foresight exercises to engage the participants. Including experienced professionals in planning a foresight analysis is an advised strategy for novice DRM authorities.
- The webinar participants highlighted short-term political thinking linked to electoral cycles and current risk analysis practices as the key impediments to implementing strategic foresight in DRM. As one of the facilitating factors, institutional recognition of the value of foresight perspec-

tive and concrete guidelines for conducting this would be helpful. For example, guidelines on assessing cascading and compounding risks in future would benefit risk assessment practitioners.

- Participatory strategic foresight engages stakeholders in critical thinking and creative activities to articulate the evolution of hazards, vulnerabilities, exposure and resilience potentials over an extended time horizon. However, as brought up by the webinar participants, it is a question of how to get the policymakers on the same page with the participants that contribute to the foresight analysis, so they could actually make use of the foresight results. Detailed joint assessment of future hazard scenarios has proven a fruitful way to create shared understanding of risks among the policy makers and operators at different levels.

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