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Research brief: Development of a Systemic Multi-Hazard and Multi-risk Framework

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MYRIAD-EU Framework: Development of a Systemic Multi-Hazard and Multi-risk Framework

Highlights

- We developed a six-steps framework for analysis and management of risk across a spectrum that ranges from single to multi- and systemic risk.
- We suggest two overarching dimensions, a specific system definition and the concept of dependencies, for a unifying multi-hazard and multi-risk framework.
    - The system definition enables a careful examination of the system boundaries which are crucial in determining how improvement will be measured for a given management option.
    - The dependencies concept, either hazard- or risk-related, enables an integration of single, multi- and systemic risks within the suggested system definition.
- Multi-hazards as well as multi-risks can be viewed as single risks in the case that there are no dependencies. Consequently, single and systemic risks can be viewed as two ends of a risk continuum where the increase in dependency is the overarching dimension for multi-risks.
- Guidance protocols were developed based on detailed stakeholder interactions to successfully navigate through the framework and each step.

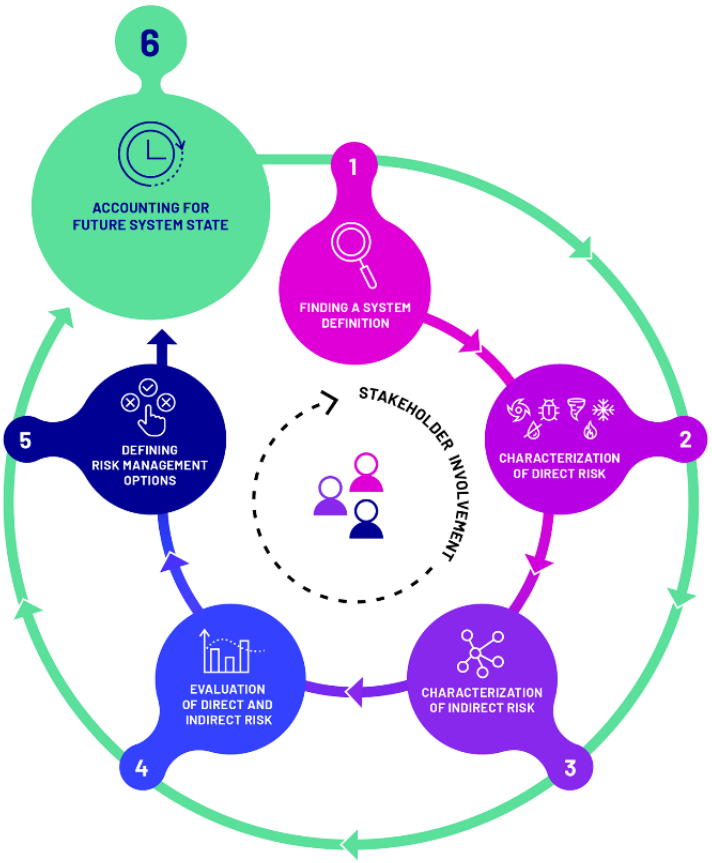
Recommendations

Single-, multi- and systemic risks should not be seen in isolation but rather as a risk continuum that arises from different levels of dependency. A focus on dependencies, for the hazard, the dynamics of exposure and vulnerability, as well as possible impacts, should therefore be taken for the assessment of risk. Viewed from a systemic perspective, the so-called failures of elements in a system can be interpreted as events that cause consequences due to dependencies. The stronger the dependencies are, the more the system level will be affected. Dependencies therefore can also be used for risk management against individual failures as well as indirect consequences using bottom-up and top-down approaches.

Context

As recent hazard events have made apparent, natural hazards are often interconnected (e.g., compound or consecutive hazards) and their impacts can spread across geographical, administrative and sectoral boundaries in our increasingly interconnected world. These multi-hazard events lay bare the need for new ways of assessing and managing their associated risks and impacts. Most risk assessment and management approaches to date do not account for these types of hazards and the interrelationships between them. The MYRIAD-EU project sets out to fill the gaps within this field of risk research and bring about a paradigm shift in risk assessment and management which can be applied to multi-hazards and multi-risks.

Based on systemic risk ideas and the contribution of experts, a new framework for the assessment and management of systemic multi-hazard and multi-risks was developed (Hochrainer-Stigler et al. 2023). Rather than providing guidelines on how to apply pre-described methods, tools, and approaches, the framework should be seen as guidance for the implementation of multi and systemic risk assessment and management. Depending on who applies the framework, different approaches and tools will prove more suitable than others, i.e., the solution to the issue at hand will be case-specific. A series of guiding questions, so-called guidance protocols, were drawn up to help in the implementation of the framework. The guidance protocols follow the structure of a stepwise analysis consisting of six steps: (1) finding a system definition, (2) characterization of direct risk, (3) characterization of indirect risk, (4) evaluation of direct and indirect risk, (5) defining risk management options, and (6) accounting for future system states (see Figure below). The framework is currently being tested in five MYRIAD-EU pilots, with feedback from stakeholders on the ground effectively shaping the iterative update of the framework.



Six-step framework for individual, multi-, and systemic risk analysis and management. Source: Hochrainer-Stigler et al. (2023).

Want to know more?

- **Full reference**: Hochrainer-Stigler, Stefan, Robert Šakić Trogrlić, Karina Reiter, Philip J. Ward, Marleen C. de Ruiter, Melanie J. Duncan, Silvia Torresan et al. "Toward a framework for systemic multi-hazard and multi-risk assessment and management." *Iscience* 26, no. 5 (2023).
- **Link to paper:** https://www.cell.com/iscience/pdf/S2589-0042(23)00813-1.pdf

- **MYRIAD-EU website: www.myriadproject.eu**
- **Twitter**: @Myriad_EU

- **Contact**: Stefan Hochrainer-Stigler (hochrain@iiasa.ac.at)