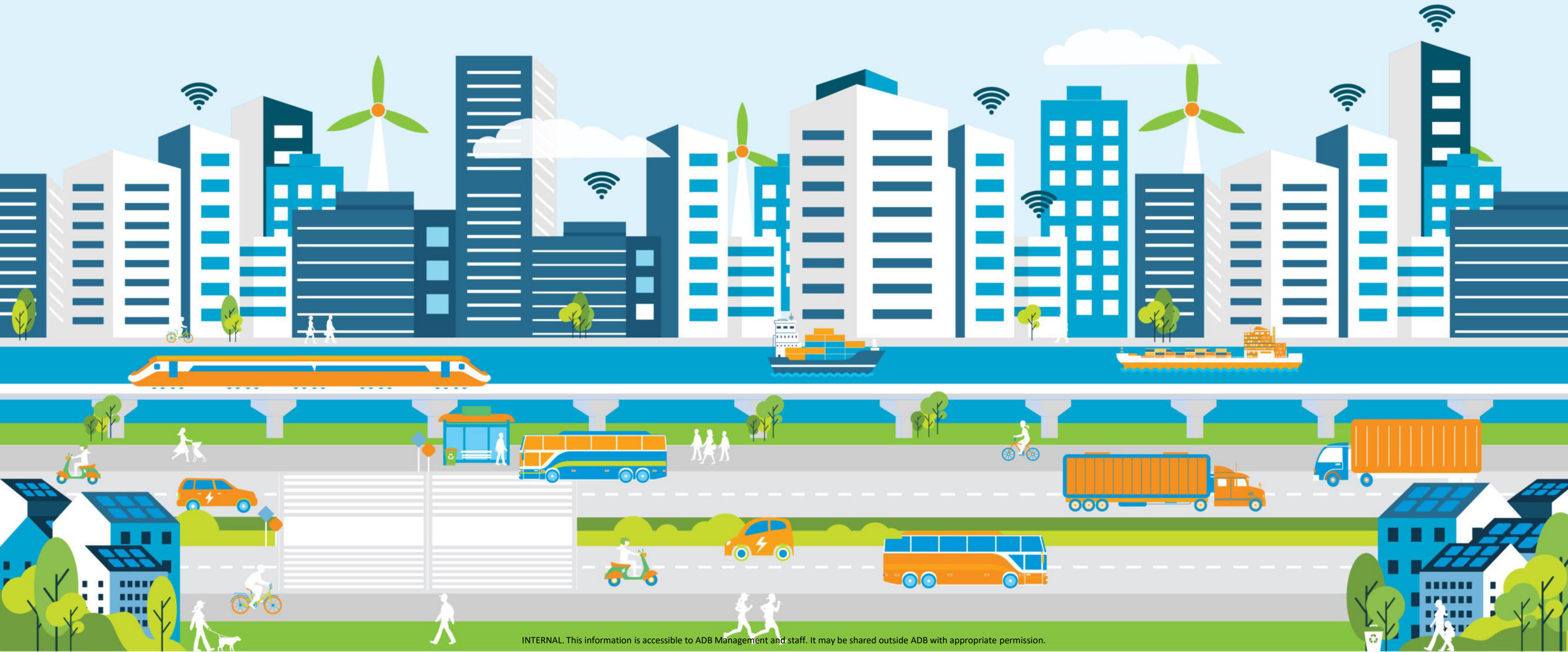
ASIA AND THE PACIFIC TRANSPORT FORUM 2024

CLEAN TRANSPORT FOR ALL

14–17 May 2024 | ADB Headquarters, Manila, Philippines



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ASSESSING MULTI-HAZARD RISK & RESILIENCE OF TRANSPORTATION INFRASTRUCTURE

Dr. Elco Koks

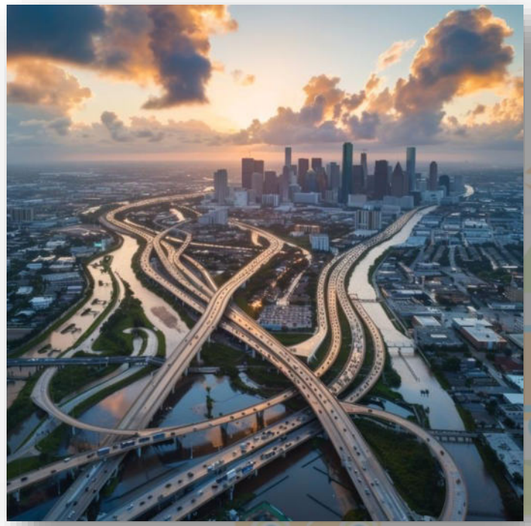
Associate Professor, Institute for Environmental Studies, Vrije Universiteit Amsterdam

What determines climate risks to transport infrastructure?

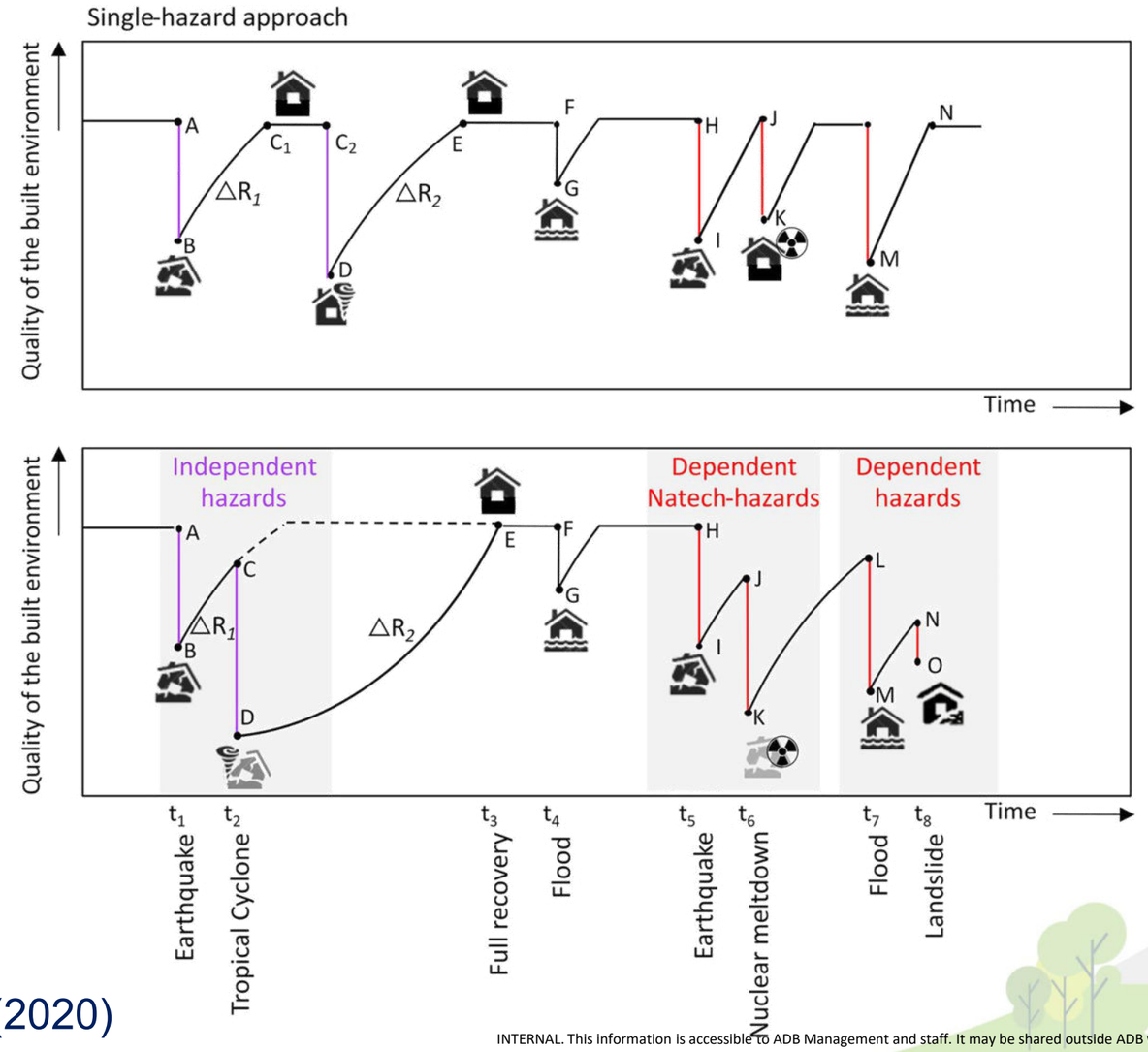
Asset age and detoriation

Exposure to climate extremes

Network complexity & dependencies



From single to multi-hazard



De Ruiter et al. (2020)

From theory to implementation. A multi-layered approach

Multiple Hazard Database

Hazard footprint

Asset-Level Exposure & Risk

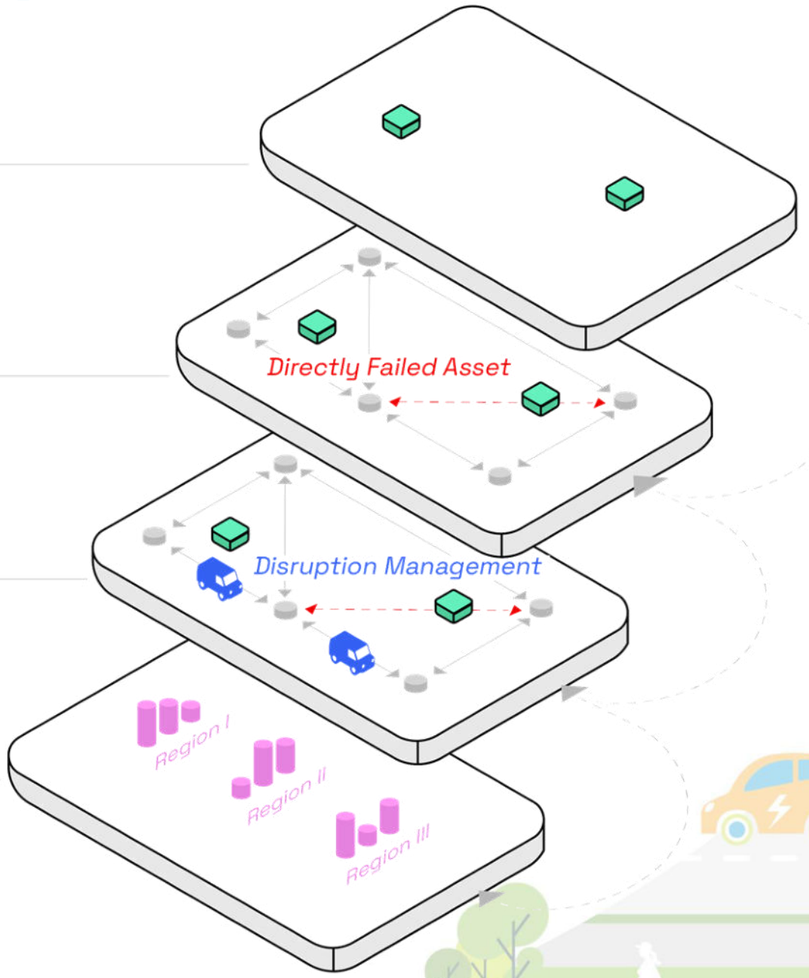
Origin/Destination

Network Criticality Analysis

Infrastructure Services

Economic Losses & Risk

Regional loss metrics



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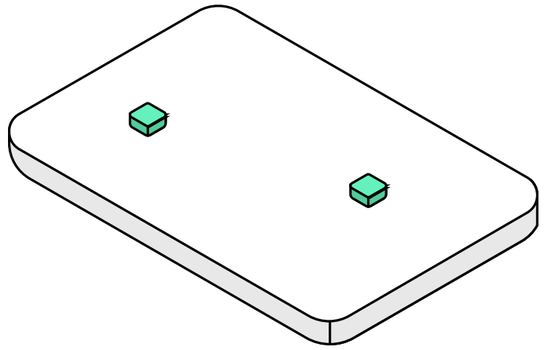
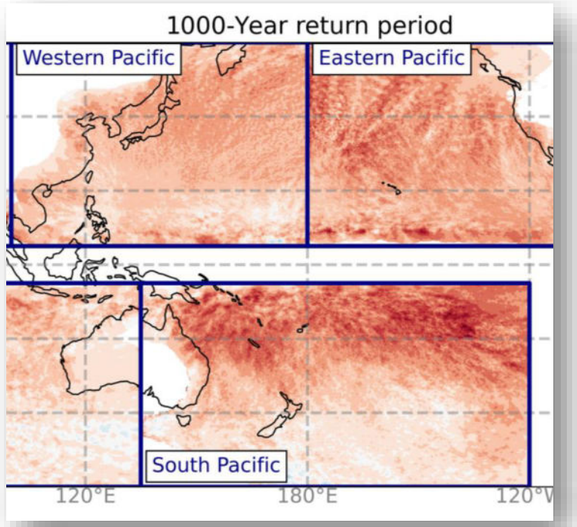


Hazard information

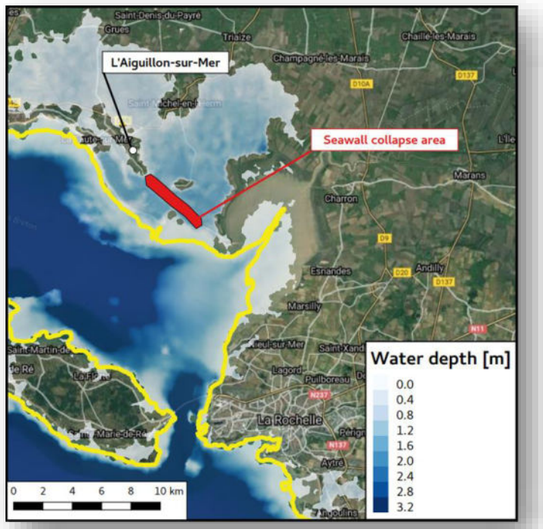
An analysis of the consequences starts with (spatial) data on various natural hazards, weather extremes, and climate change.

Return-period footprints



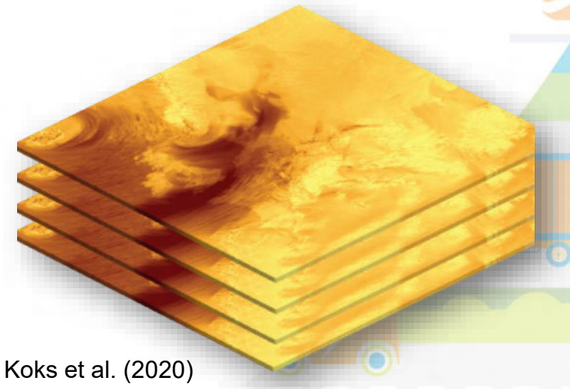
Bloemendaal et al. (2022)

Historic events



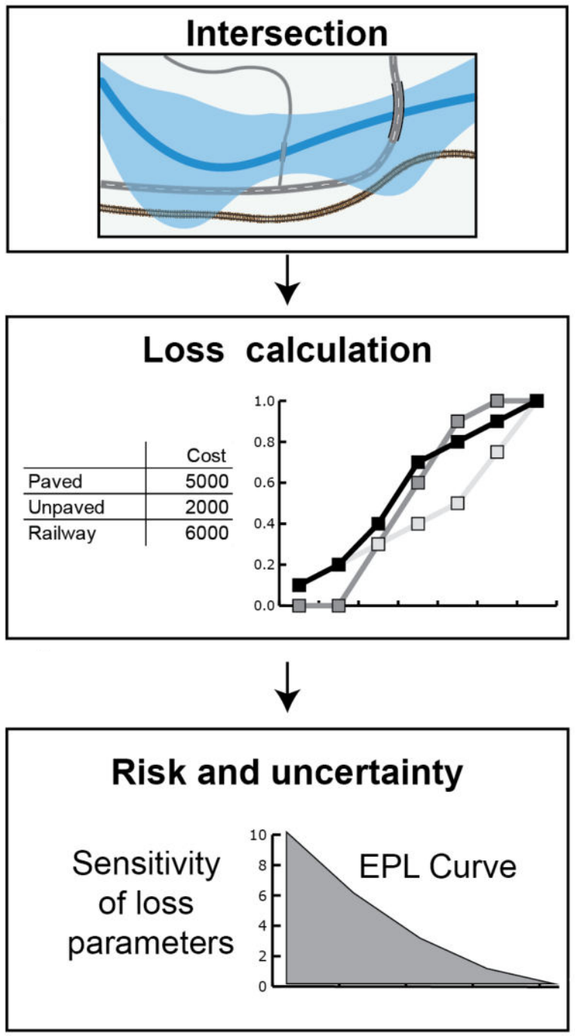
Koks et al. (2023)

Stochastic event sets

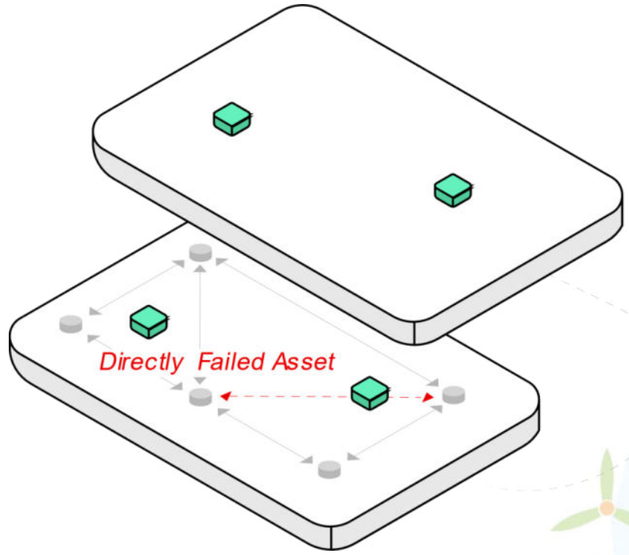


Koks et al. (2020)

Asset-level exposure and risk

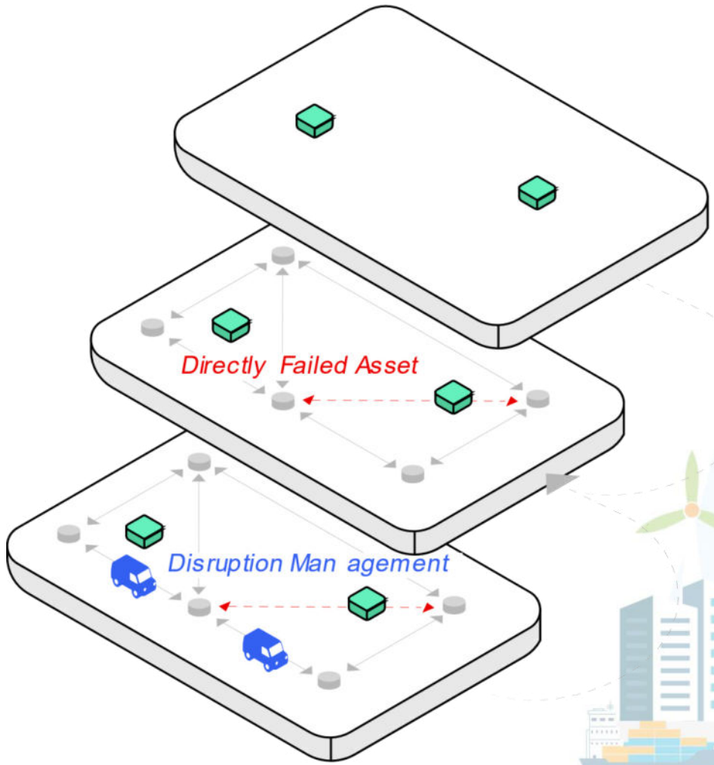


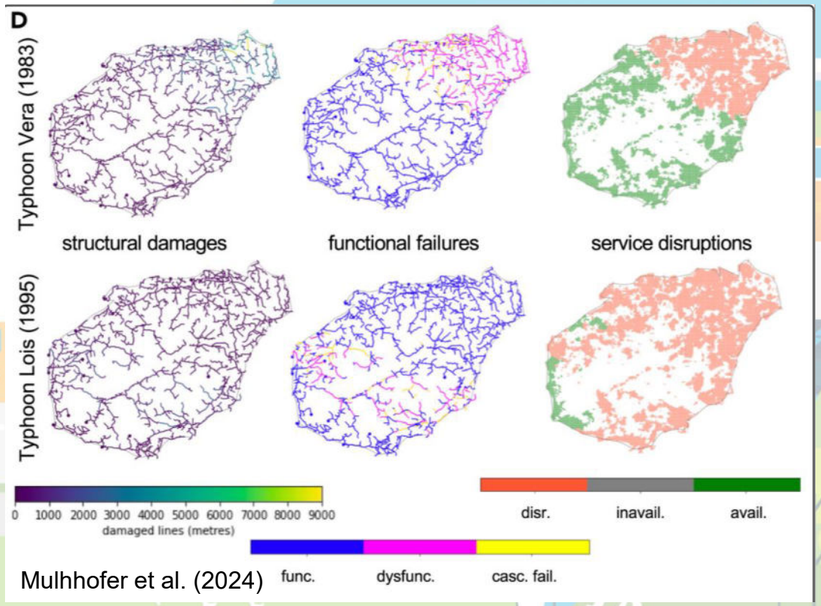
- Combining hazard information with spatial information of the network allows for assessing exposure and, when combined with vulnerability information, damage.
- Vulnerability information remains highly sparse → often many unknowns and heavily based on assumptions.
- When assessing multi-hazard risk, one needs to gain a thorough understanding of the level of independence (or dependence) between hazards and losses



Network criticality analysis

- Estimating and disrupting services by combining:
  - network information (e.g. topology characteristics)
  - the assets that are potentially vulnerable (hotspot analysis)
  - information about network usage (capacity and usage)
- This information combined allows for more complete stress-testing of networks
- Resulting in a better estimation of the real consequences (and costs) of disruptions. And helps prioritize investments.

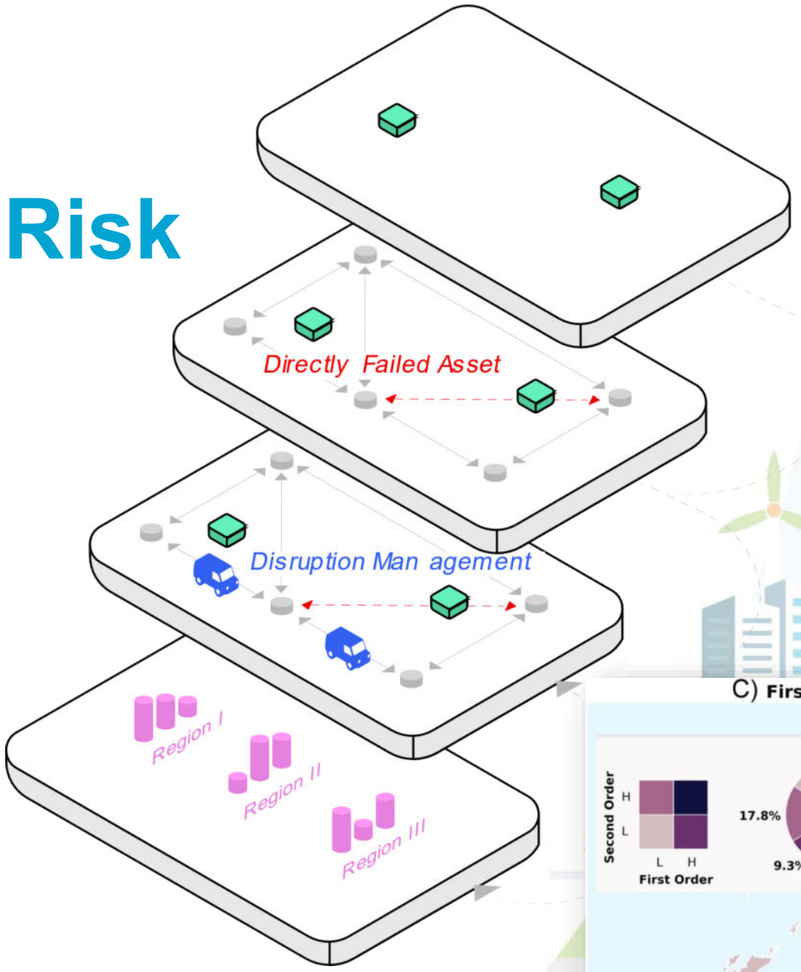


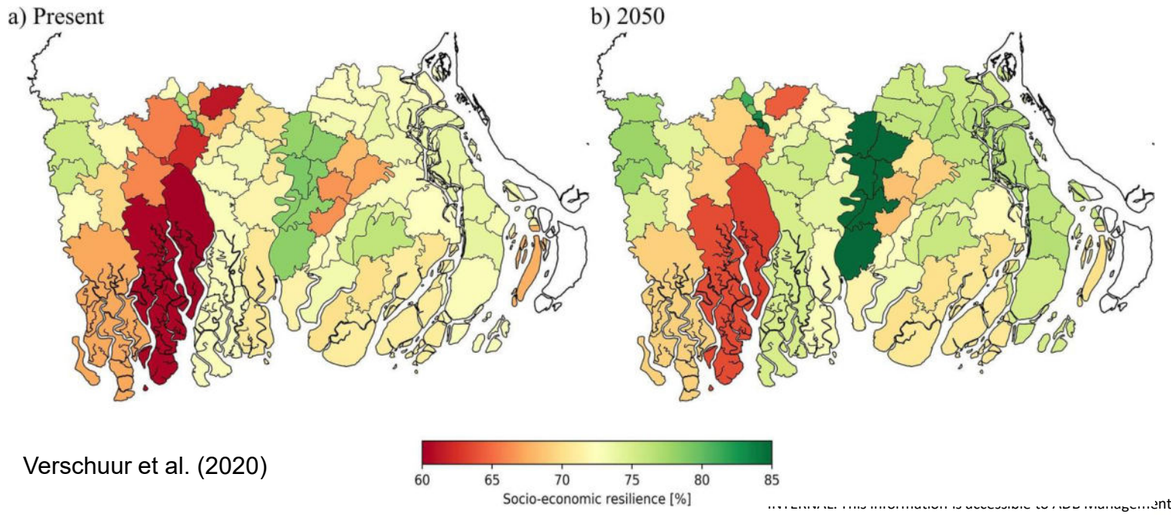


Mulhhofer et al. (2024)

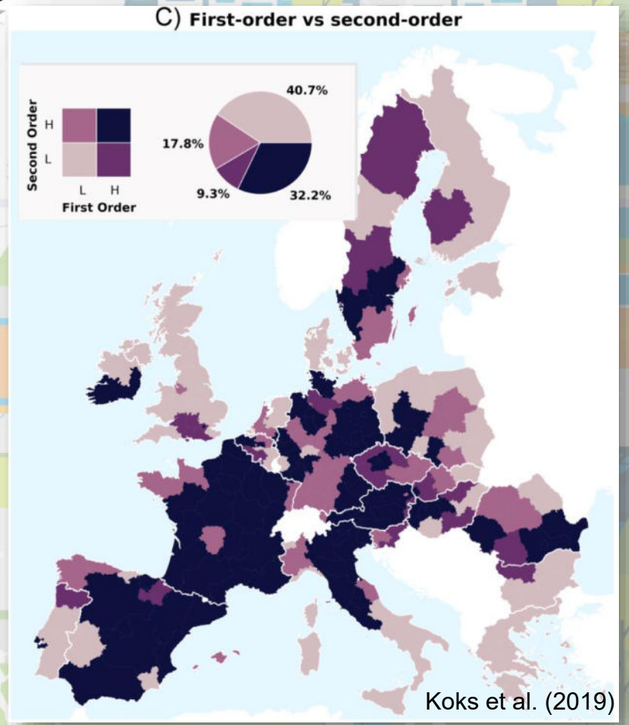
Socioeconomic Losses & Risk

- Translating service disruptions into societal impacts.
- Monetary impacts can be helpful to decide where to invest, but do not always provide the full picture.
- Accessibility to local communities may be low in direct financial costs but may have large social welfare costs.
- One may want to consider non-monetary metrics as well, such as accessibility to hospitals, and number of people affected by closure of road segments.





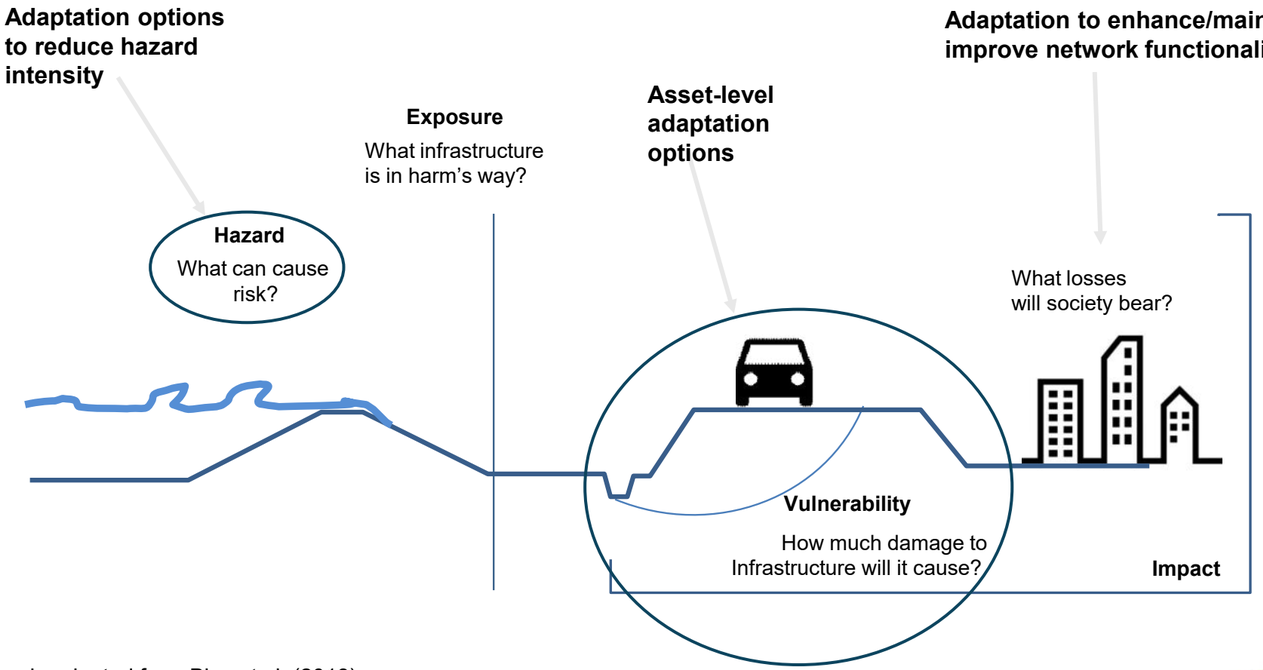
Verschuur et al. (2020)



Koks et al. (2019)

From risk to improving resilience

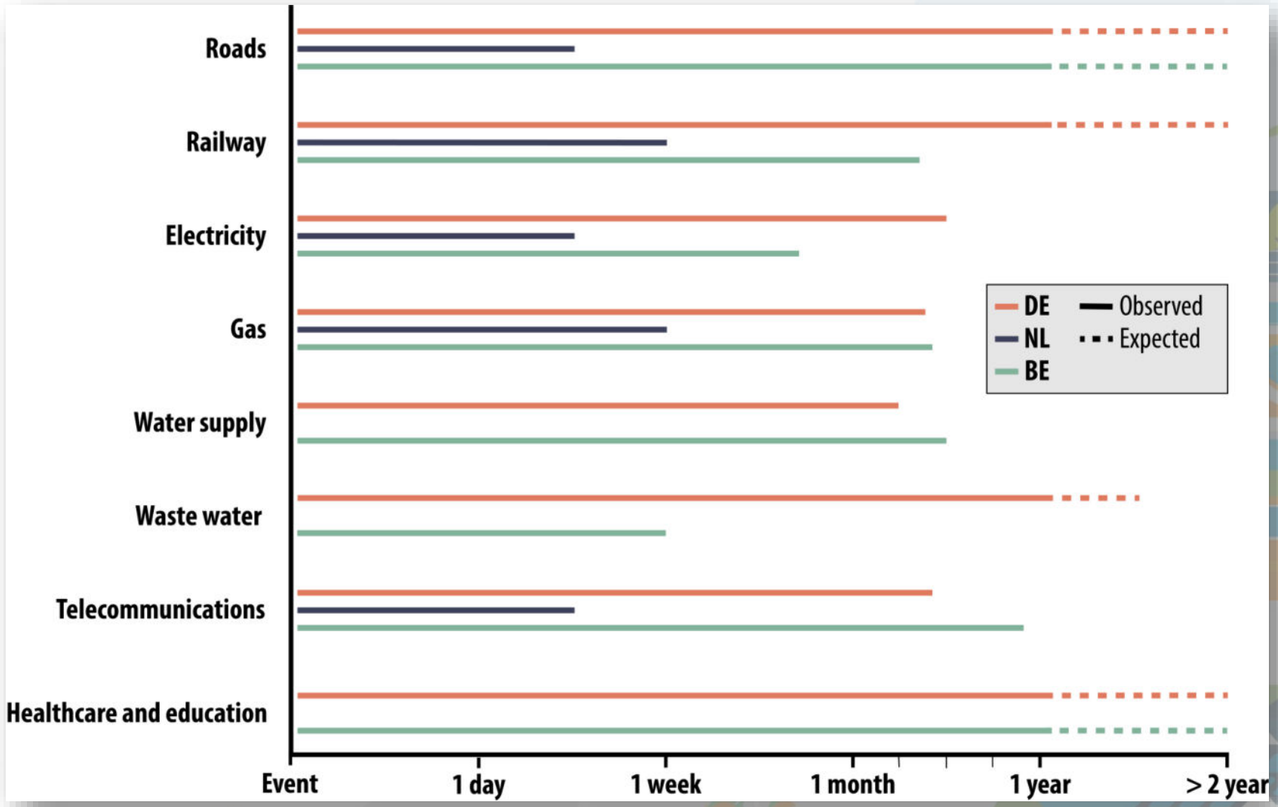
- A multi-layered approach allows for identifying adaptation options within all parts of the transportation system.
- Many gaps of knowledge in interdependent systems, multi-hazards, and multiple adaptations
- Transformative vs incremental adaptation! <- *more on Thursday*



Example adapted from Bles et al. (2018)

Where science meets practice

- There is a wealth of models and tools developed already, but collaboration is required to really advance further:
  - Fill knowledge gaps on data and information (e.g. maintenance costs, reconstruction capacities, reconstruction durations)
  - Critical reflection on assumptions and model decisions
  - Align model outputs and end user KPI's



Koks et al. (2022)

Moving towards application

- The previously presented approach will be applied in three DMCs: Pakistan, Papua New Guinea and Tajikistan.

- We will assess asset-, network-, and system-level impacts due to climate extremes, and will develop a first set of adaptation strategies to reduce those impacts.

- It will be a fast-track analysis, aiming to identify important bottlenecks within their transportation systems → further analysis will be needed for detailed analysis on those!

Key take-aways

- The tools and methods to assess climate risks of transportation infrastructure are well-advanced, now we need to start putting it into practise.

- Multi-hazard risk requires a new way of thinking, but also comes with exciting research avenues.

- Adaptation options can be implemented at multiple levels within the system: the next steps are now to assess under which conditions certain options work most optimal.

THANK YOU!

For further questions, I am happy to have a chat these days!

Or contact me at elco.koks@vu.nl