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Critical Infrastructures – Concepts and five challenges from a risk perspective on interdependencies

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Critical Infrastructures?

- *"…those assets or parts thereof which are essential for the maintenance of critical societal functions, including the supply chain, health, safety, security, economic or social well-being of people"* (EPCIP – COM, 2006)
- Brief history – From sector regulation towards holistic infrastructure protection
  - Starting point for the field; Executive Order 13010 (Executive Order, 1996), creating PCCIP in the USA.
  - 9/11 in 2001 and Hurricane Katrina in 2005 illuminated the importance and vulnerability of critical infrastructure. Creation of DHS and intensified work. From terrorism towards all-hazard approaches.
  - In Europe, the EPCIP program was initiated in 2006.
  - Today most countries around the world have programs focused towards CIP, i.e. moving from earlier "sector-divided" approaches towards more holistic infrastructure protection approaches.
  - A response to the interconnectedness of todays infrastructures – the backbone of society.

Why?

- Society heavily dependent on the services of critical infrastructures, widespread disruption entails large-scale societal impacts.
- Hence:
  - Proactive risk and vulnerability methods and actions fundamental
  - Increasing our understanding the limits of critical infrastructures of essence
- However, there exist several research challenges for a holistic understanding and a need for method development in this field.

Five challenges

I. Capturing interdependencies between societal functions
(SRA-Nordic contribution by Henrik Hassel et al.)

II. Modelling and simulation of interdependent critical infrastructures
(SRA-Nordic contribution by Linn Svegrup et al.)

III. Safety margins, recovery and resilience of critical infrastructures
(SRA-Nordic contribution by Finn Landegren et al.)

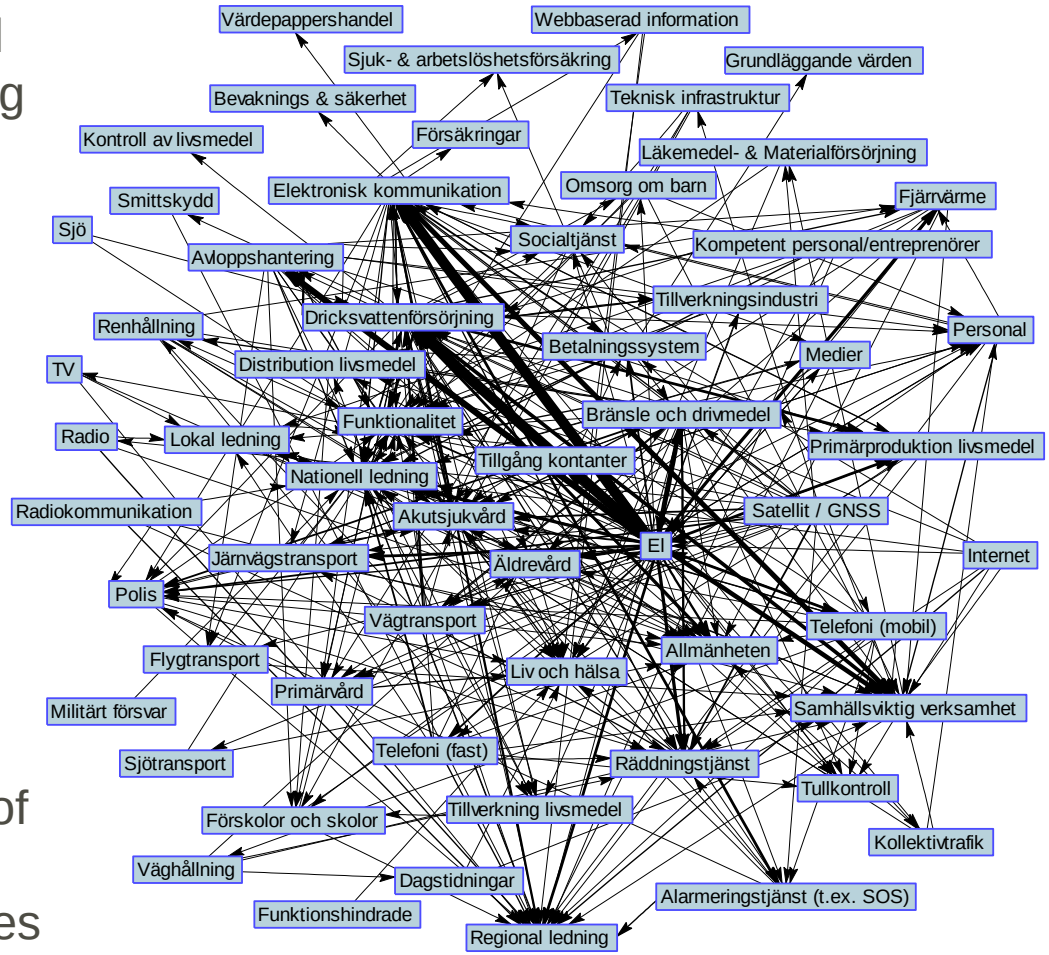
IV. Empirical data for cascading effects in critical infrastructures
(SRA-Nordic contribution by Björn Arvidsson et al.)

V. Risk governance of critical infrastructures
(SRA-Nordic contribution by Alexander Cedergren et al.)

Challenge 1

Interdependencies between societal functions

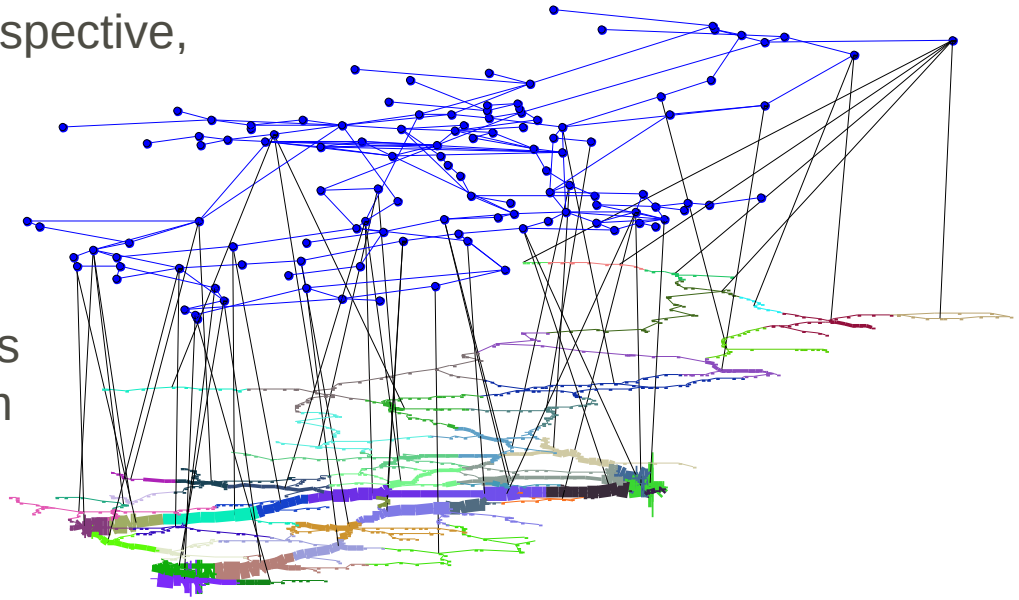
- Dependencies between societal functions seems to be increasing
- The overall “societal system” more tightly interconnected
- Trends such as globalisation, urbanisation, and technological development drivers for efficiency but also introduces new vulnerabilities and changes the risk picture.
- The understanding of the interconnectedness of these functions and the mechanisms of how consequences can spread limited. Need for new approaches and empirical data.



Challenge 2

Modelling and simulation of interdependent critical infrastructures

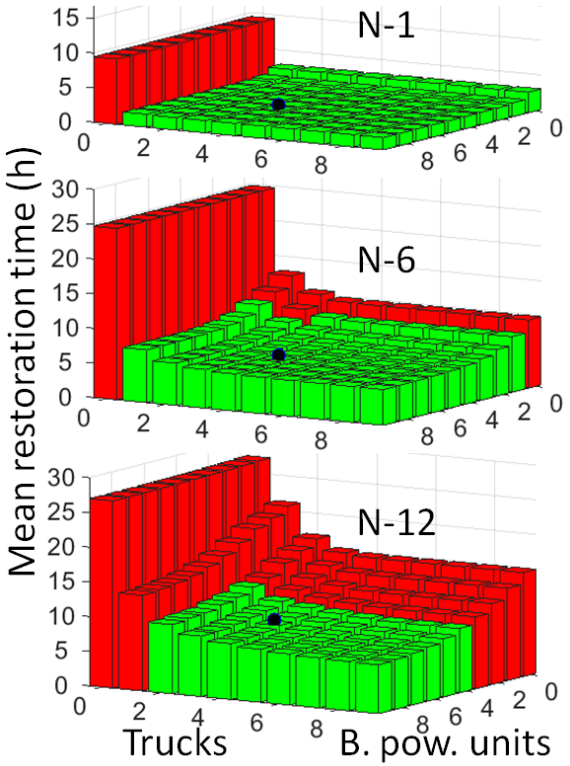
- Technical infrastructures, such as power systems, railways, air transportation and telecommunication, form a subpart of critical infrastructures.
- Here data of individual systems exist, however data of their interdependencies and models of accounting for the “system-of-system” behaviour of interdependent technical infrastructures lacking.
- From a Swedish governance perspective, adequate mechanisms for managing risk and vulnerabilities from “system-of-system” perspective lacking.
- Efforts needed to develop models and simulation methods to inform decisions from a more holistic perspective.



Challenge 3

Safety margins, recovery and resilience of critical infrastructures

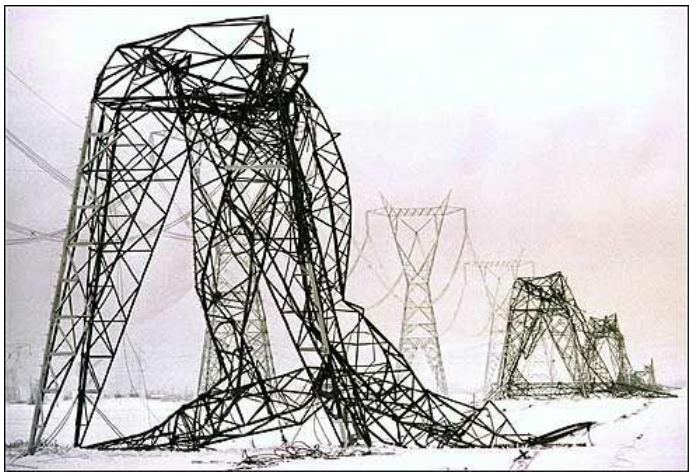
- Technical infrastructures are inherently socio-technical by nature, the infrastructures are designed, operated, maintained and restored by humans.
- In general, research in this field tends to focus rather narrowly on “everyday” incidents (based on historical data) and technical aspects.
- To better grasp the resilience of infrastructures more work is necessary towards their limits towards large-scale disruptions, e.g. their ability to recover functionality.
- Approaches needs to merge the pure technical parts of the infrastructures with models able to capture the capacity of the organisation in responding to disruptions beyond normal.

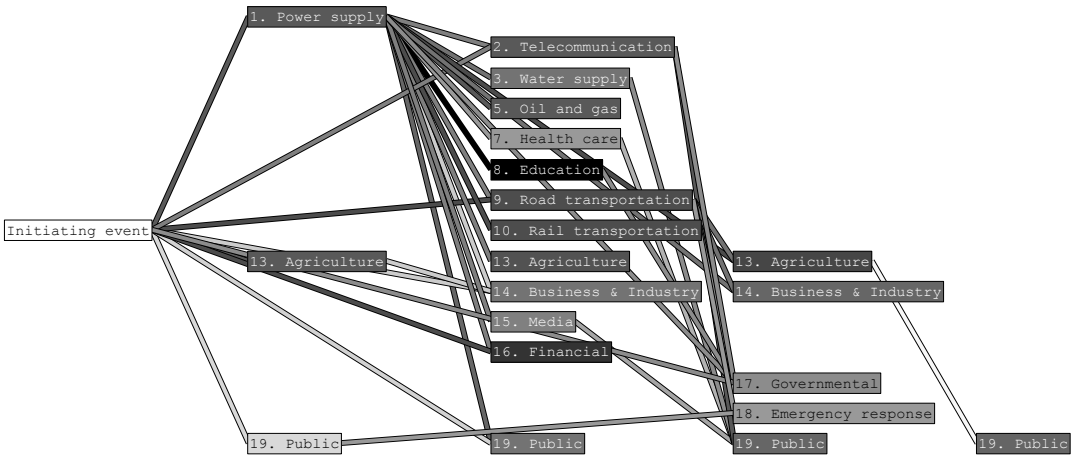


Challenge 4

Empirical data for cascading effects between critical infrastructures

- To support the research in the field of critical infrastructures, one important aspect is the access to empirical data.
- In general, good quality data with respect to the consequences that arise when infrastructure collapses are lacking. For example traditional accident investigation methods do not focus on interdependencies.
- This type of data is essential to improve our understanding of how society is dependent on the services infrastructures provide, how this picture has changed and increase our understanding of the mechanisms behind interdependencies leading to cascading effects.





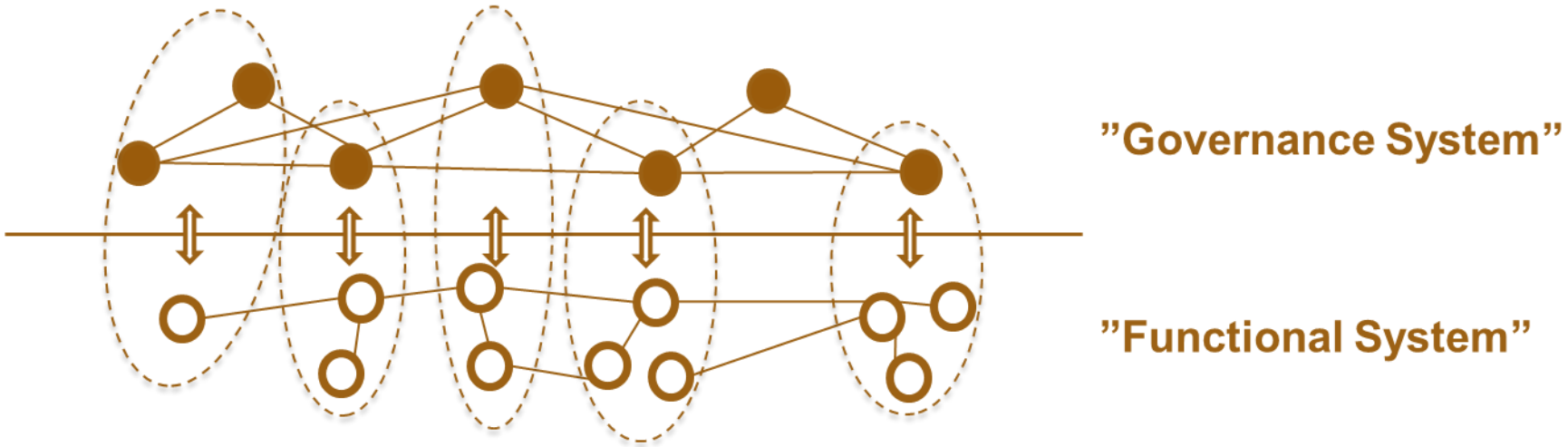
Challenge 5

Risk governance of critical infrastructures

- The operation and management of many critical infrastructures has become divided between a larger set of stakeholders, resulting in a dispersion of responsibility.
- In this institutionally fragmented setting, traditional risk management tools are not always suitable to deal with risks in a feasible manner.
- No single stakeholder has the superior authority or overview to make and implement holistic risk-reducing decisions.
- Research needs related to stakeholders' diverse framings of risk, communication challenges, sub-contracting and cross-scale interactions.

Centre for Critical Infrastructure Protection Research (CenCIP)

- Newly formed centre of excellence at LU, 2015-2020 (MSB).
- Descriptive and normative research within three areas:
  - Interdependencies and societal consequences
  - A holistic view on terms, concepts and methods
  - Governance, measuring and learning



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