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Risk Governance: Overcoming Silo Thinking and Approaches

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Hypothesis

- Prevailing state of risk research and governance regimes are (still sometimes) characterized by 'silo thinking', i.e. compartmentalized, disciplinary and sectorial, fragmented, in contrast to evidenced needs.

Reflections on ‘Evidenced Needs’ (I)

- Increasing physical and non-physical integration and interconnectedness of systems (‘system-of-systems’) has been yielding complex behavioral patterns with cascades, bifurcations, regime shifts, feedback loops; localized events can escalate rapidly
- Widening gaps between designing and operating systems and our knowledge about them; classical analytical tools like logic trees come to their limits

Quick Look at the European Electricity Supply System

- Geographical extension (from Lisbon to Bucarest) of the synchronized grid, increased power and transborder exchange, lack of investments
- Major organizational (from monopoly to competitive market, unbundled corporations, short term trading) and structural changes (higher share of intermittend sources, larger distances between producers and consumers) are pushing the system closer and more often to its limits
- Lack of sufficiently proven strategies (‘Energiewende as a large experiment’), of holistic thinking (generators <u>and</u> grid) and of awareness of possible disruptions and new threats
- Blackout patterns demonstrate importance of contextual and other ‘soft’ factors; technological changes may add new risks (e.g. cyber) to appreciated benefits

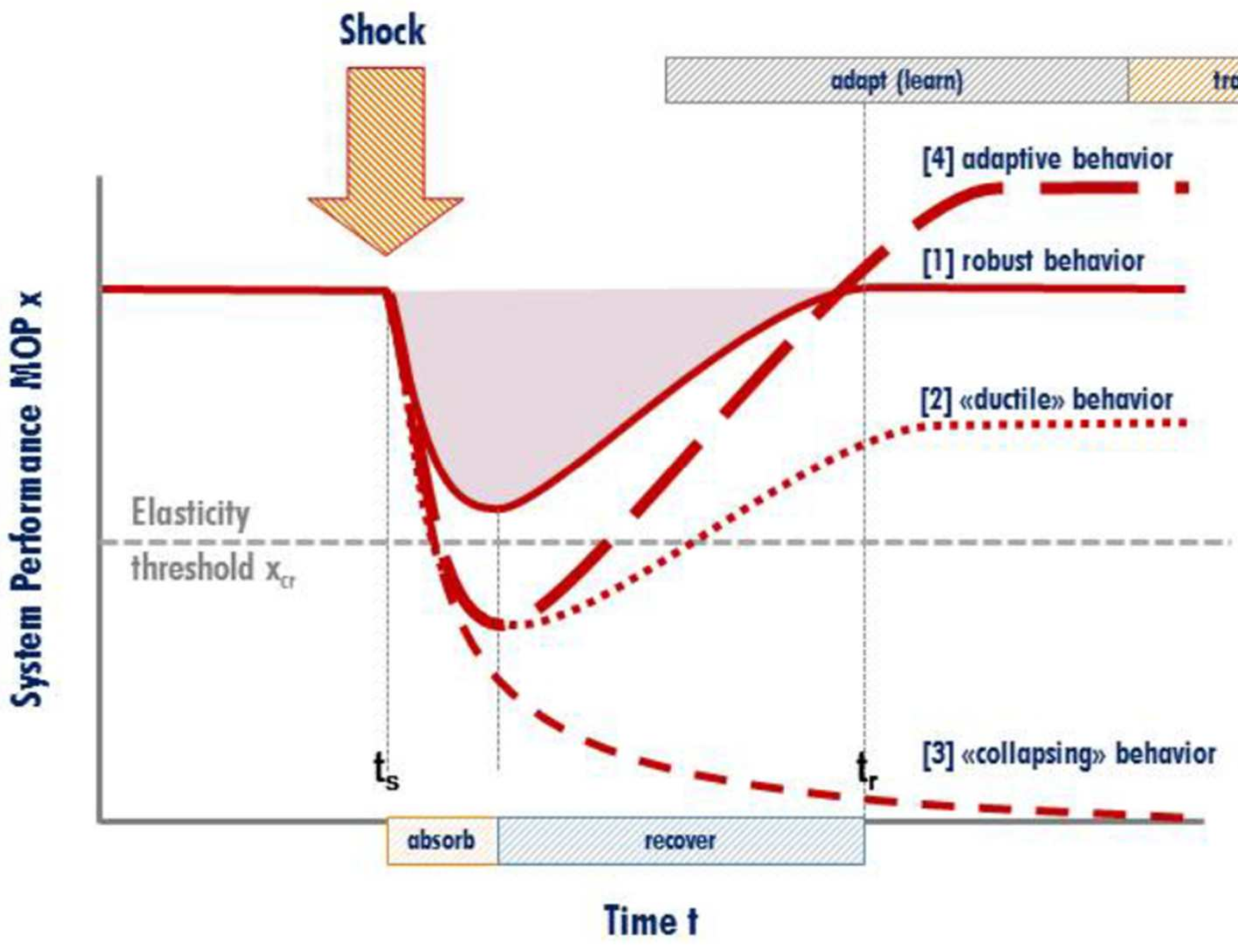
List of Major Blackouts of Different Location, Size and Duration

Blackout		Loss [GW]	Duration [h]	People affected	Main causes
Aug. 14, 2003	Great Lakes, NYC	~ 60	~ 16	50 Mio	Inadequate right-of-way maintenance, EMS failure, poor coordination among neighbouring TSOs
Aug. 28, 2003	London	0,72	1	500´000	Incorrect line protection device setting
Sept. 23, 2003	Denmark / Sweden	6,4	~ 7	4,2 Mio	Two independent component failures (not covered by N-1 rule)
Sept. 28, 2003	Italy	~ 30	up to 18	56 Mio	High load flow CH-I, line flashovers, poor coordination among neighbouring TSOs
July 12, 2004	Athens	~ 9	~ 3	5 Mio	Voltage collapse
May 25, 2005	Moscow	2,5	~ 4	4 Mio	Transformer fire, high demand leading to overload conditions
June 22, 2005	Switzerland (railway supply)	0.2	~ 3	200´000 passengers	Non-fulfilment of the N-1 rule, wrong documentation of line protection settings, inadequate alarm processing
Aug. 14, 2006	Tokyo	?	~ 5	0.8 Mio households	Damage of a main line due to construction work
Nov. 4, 2006	Western Europe (planned line cut off)	~ 14	~ 2	15 Mio. households	High load flow D-NL, violation of the N-1 rule, poor inter-TSO coordination
Nov. 10, 2009	Brazil, Paraguay	~14	~4	60 Mio	Short circuit on key power line due to bad weather, Itaipu hydro (18 GW) shut down
March 11, 2011	Northern Honshu	41	days		Grid destruction by earthquake & tsunami/supply gap

Reflections on ‘Evidenced Needs’ (II)

- Post-shock / crisis behavior and recovery measures make the difference calling for a paradigm shift towards resilience
- Systems, predefined as ‘closed’, may turn into ‘open’ systems under severe (accident) conditions when closely interacting with their environment, Fukushima Dai-ichi as an example

Concept of Resilience



Lessons Learned From 'Fukushima' Relating to Risk Analysis (PSA)

- Institutional-organizational deficits as ultimate cause of the disaster need to be taken into consideration
- Lack of imagination and ignorance of cascades/feedbacks (e.g. influence of harsh environment and explosion in reactor buildings on emergency response) became obvious, demonstrating the inadequacy of knowledge-based causal chains based, thus calling for support by computer-based 'scenario generators'
- Restricting accident management measures to 'planned, trained actions' may lead to unrealistic estimates, as conditions may differ from what was assumed before
- Consequence (damage) indicators focused on radiation-induced health and environmental impact and financial losses, may be too limited
- The basic approach that a system behavior can be modeled by the 'sum of the behavior of its parts' turned out to be highly questionable

Reasoning Challenges / Requirements

- Fundamentally new thinking in terms of socio-technical systems, trade-offs to be respected
- Fostered trans-disciplinary and trans-sectorial research to overcome limitations of classical approaches, methods and frameworks to better understand complexity and design more resilient systems and procedures
- Platforms for global dialogue and cooperations

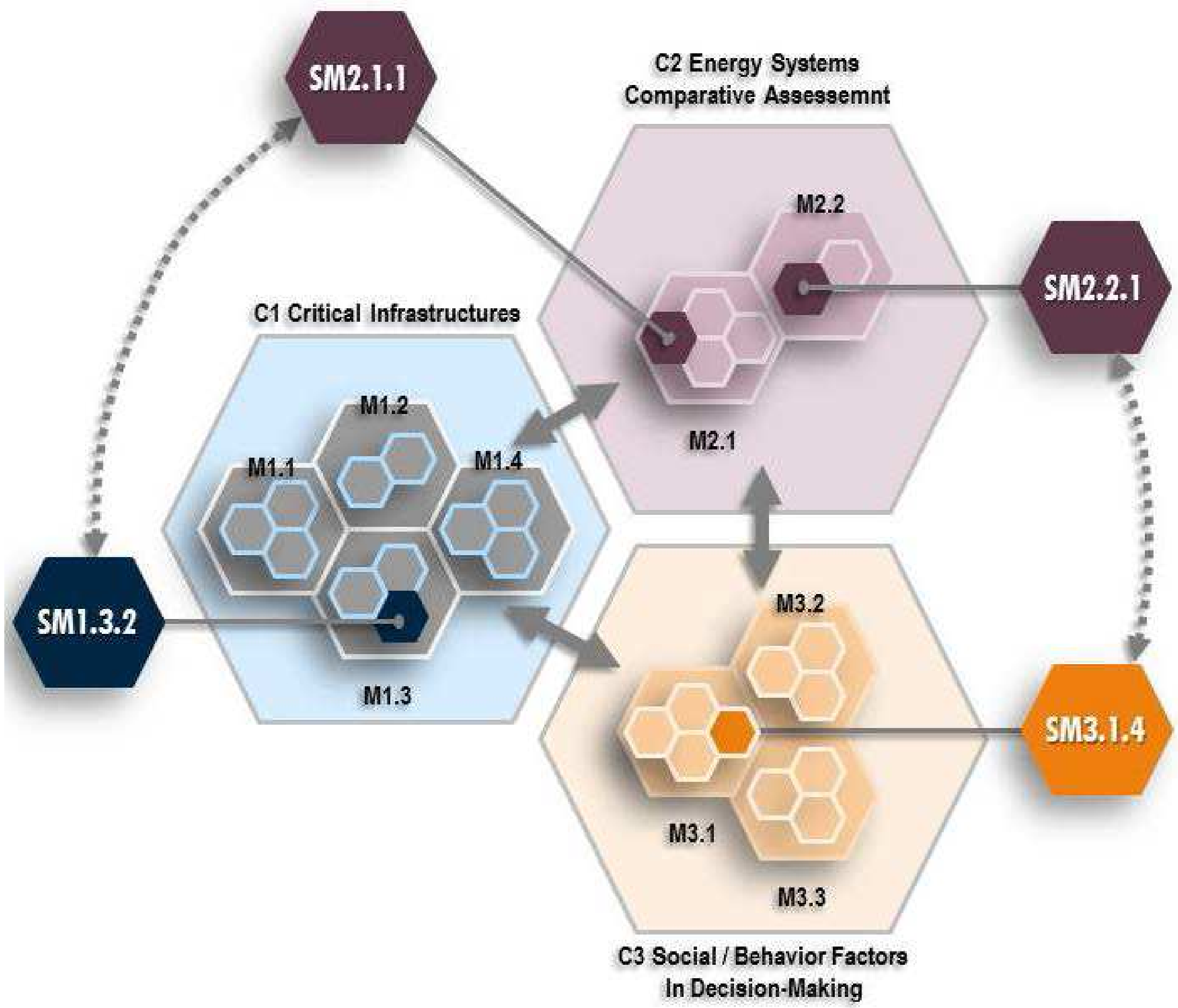
Achievements | Encouraging But Still Increasable Steps

- Foresightful (2003) establishment and continous support of IRGC with timely pioneering work in key areas, in particular development of Risk Governance Core Concept and its application and promotion
- Horizon 2020 first theme-oriented EU research program
- Creation of the ETH Risk Center (2011) with professors from 7 departments, focused on novel fundamental research and interfaces with science, industry (Partnership Council) and public-policy
  - ➡ first joint research project with 8 PhD students
  - ➡ development of concepts like IRM, resilience
  - ➡ outreach to S'pore: Program on Future Resilient Systems (FRS), proposed to NRF, in cooperation with NUS/NTU/SMU (a group of max. 60 researchers envisaged)

Overview of Three Research Clusters and Nine Research Modules of the Proposed FRS Program aiming to build a Sound Scientific Foundation for the Development of Future Resilient Systems

- **Interdependent Critical Infrastructure Systems**
  - **M1.1** Understanding Interdependencies
  - **M1.2** Modeling Complex, Socio-Technical Systems
  - **M1.3** Characterization of Consequences
  - **M1.4** Strategies and Tactics to Improve CI-Systems
- **Energy Systems and Comparative System Assessment**
  - **M2.1** Energy System Resilience Assessment
  - **M2.2** People and Operations in Resilient Systems
- **Social and Behavioral Factors in Decision-M.**
  - **M3.1** Human DM is Risky, Dynamic and Complex Env.
  - **M3.2** Sustainable Energy Demand
  - **M3.3** Ethnic Power Relations and Conflicts in SEA

Synergies Within and Between FRS Research Clusters



Embedding of the FRS in an Inner Research-Institution Layer and in an Outer Premium-Partner Layer

Thank you for your attention !