Challenges in designing resilient socio-technical systems

A case study of decision-making in railway tunnel projects

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Introduction

*"It appears that **everything** (organizations, cities, nations) and **everybody** (from schoolteachers to the U.S. president) **can and should be resilient**"*

(Boin, Comfort, & Demchak, 2010)

- National strategy for protection of societal functions
- Increase resilience of society and its critical infrastructures
- Aim of this case study to analyse:
  - To what extent resilience is considered during design of railway tunnel projects
  - Applicability of a RE perspective

Method and material

- 16 semi-structured interviews
- The design stage of railway tunnel projects
- Decision-making regarding safety measures

- 6 railway tunnel projects
- Including 28 tunnels
- Tunnel lengths between 180m and 8,6km
- Document studies

A Resilience Engineering perspective

- Four factors have provided the basis for analysis

- Influential for a system's resilience

- Builds upon insights from vulnerabilities in decision-making (Woods, 2003) and includes:

  - Failure to revise assessments

  - Breakdowns at the boundaries of organizational units

  - Past success as a reason for confidence

  - Fragmented problem solving

- Formed the perspective from which decision-making has been studied (cf. Hale & Heijer, 2006)

Decision-making in railway tunnel projects

- Two main groups of stakeholders
- Building permit required
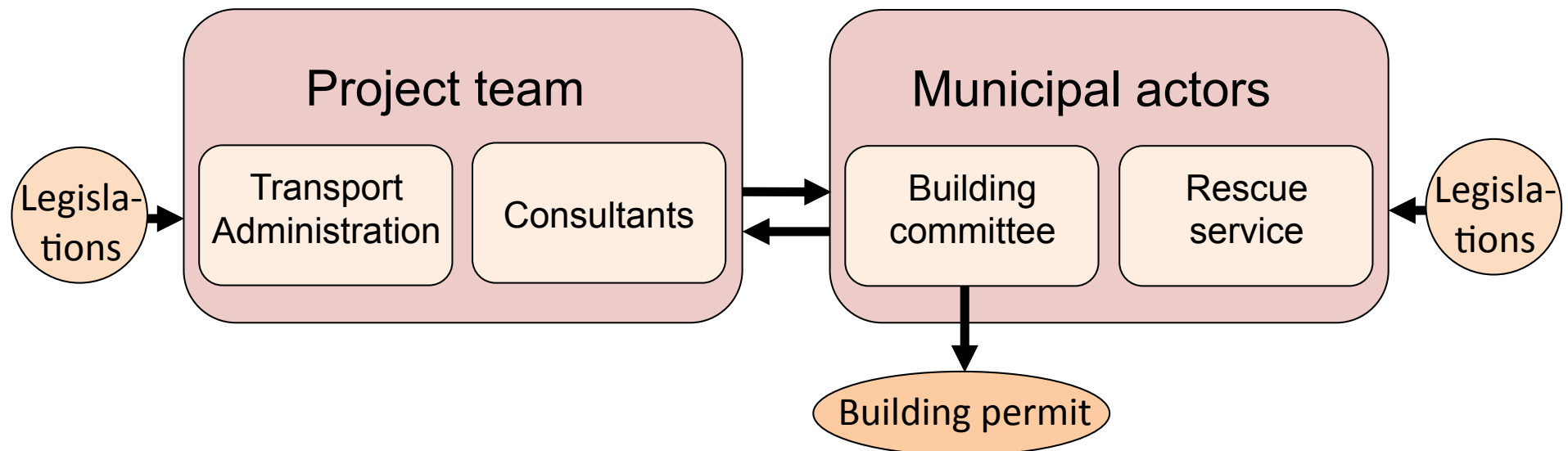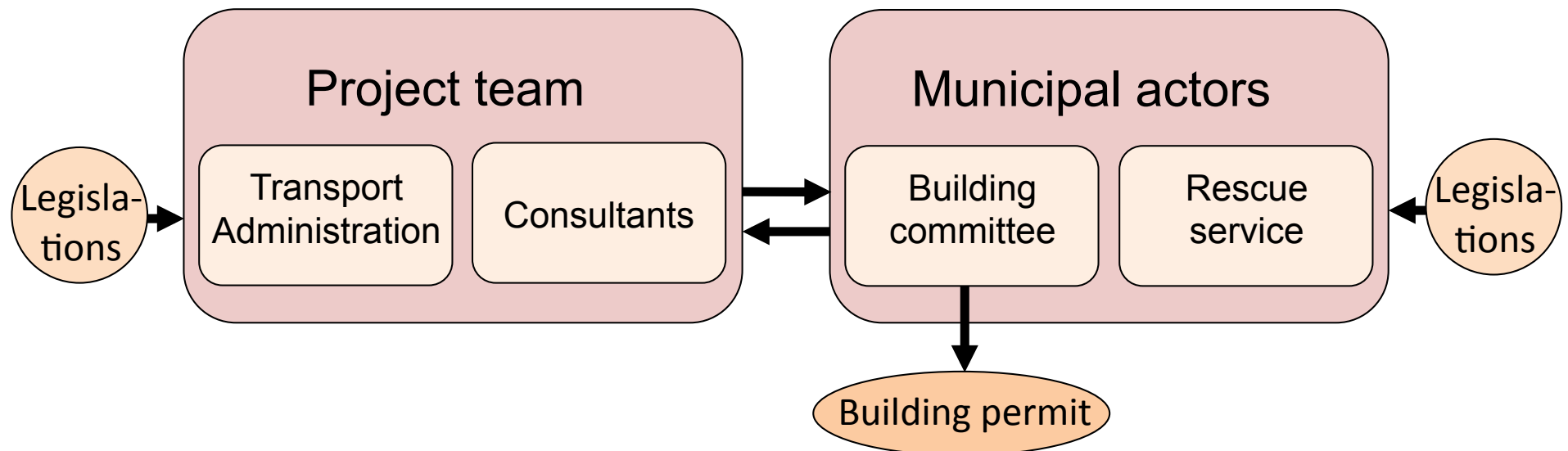- Different legislations, goals, perspectives
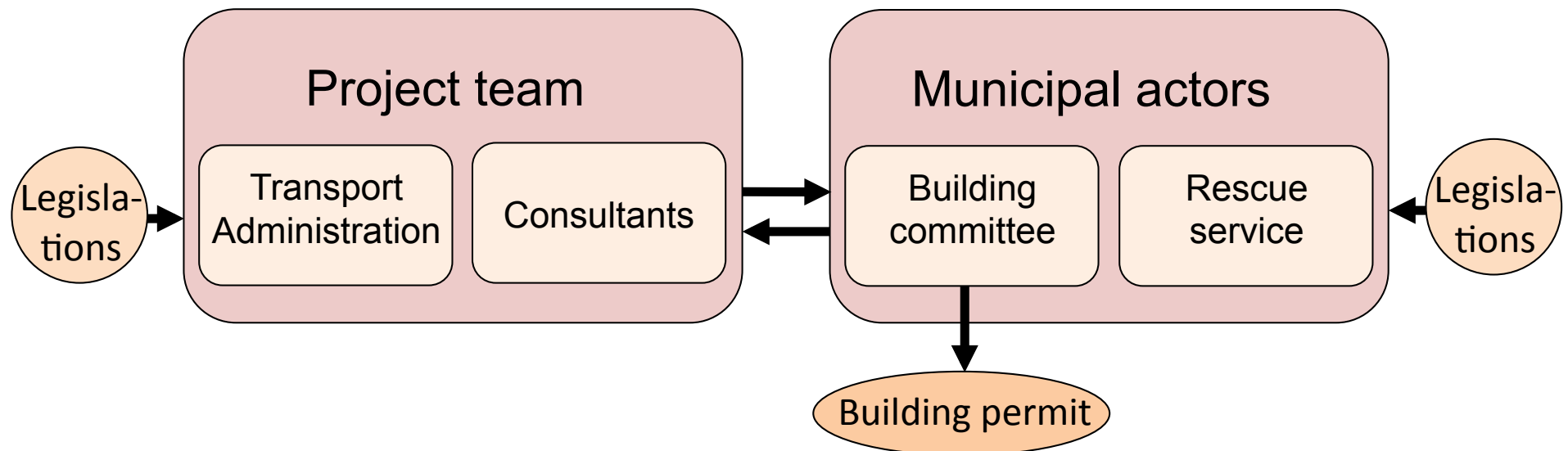
A Resilience Engineering perspective

- Failure to revise assessments
- Breakdowns at the boundaries of organizational units
- Past success as a reason for confidence
- Fragmented problem solving

Failure to revise assessments

- Different legislations
- Diverse perspectives on risk and safety;
  - risk-based
  - deterministic

- Stakeholders unable to revise assessments
- Disagreements regarding legitimate "evidence"

A Resilience Engineering perspective

—   Failure to revise assessments

—   Breakdowns at the boundaries of organizational units

—   Past success as a reason for confidence

—   Fragmented problem solving

Breakdowns at the boundaries of organizational units

- Additional demands on safety measures

- *"The municipal authorities kidnapped the building permit"*

- Double binds:
  - Costs
  - Blame

A Resilience Engineering perspective

- – Failure to revise assessments
- – Breakdowns at the boundaries of organizational units
- – Past success as a reason for confidence
- – Fragmented problem solving

Past success as a reason for confidence

- Deadlocks during decision-making
- Adopting the same solutions as in previous projects

- "Precedents"
- Not primarily based on analyses

*"If we propose 500 meters, then **the rescue service feel confident…** and then we know that this will be approved,…*

… although it is not a distance that has resulted from an analysis… so you start to wonder why we are doing these analyses…"

(project team in project Å)

A Resilience Engineering perspective

- Failure to revise assessments
- Breakdowns at the boundaries of organizational units
- Past success as a reason for confidence
- Fragmented problem solving

Fragmented problem solving

- Municipal actors influential on decision-making
- Projects of national interest managed locally
- System boundaries

- Flexibility and adaptability in the face of disturbances not considered
- Limited consideration of the system's resilience
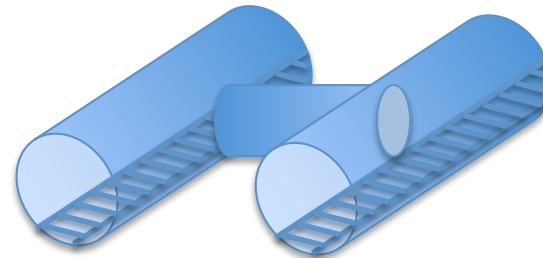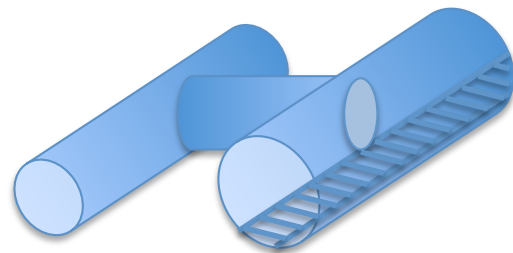
Conclusions

- Resilience gained limited attention
- The processes behind this include:
  - Diverse perspectives
  - Double binds (costs, blame)
  - Choice of system boundaries
- Efforts to make the system safe from a local perspective
- Not resilient from a regional or national perspective
- Micro-level decisions with macro-level effects
- Cross-organisational aspects should be further emphasised
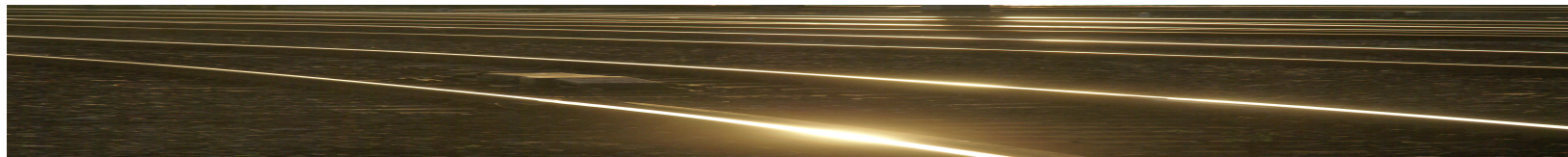
Thank you!

Questions and comments?

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