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:
  o To what extent resilience is considered during design of railway tunnel projects
  o 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

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Diagram:

- Project team
  - Transport Administration
  - Consultants

- Municipal actors
  - Building committee
  - Rescue service

- Building permit

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Legislations flow to:
- Project team
  - From Transport Administration
  - From Consultants

Legislations flow to:
- Municipal actors
  - From Building committee
  - From Rescue service

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Building permit flows to:
- Project team
  - To Municipal actors
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”

Diagram:
- **Project team**
  - Transport Administration
  - Consultants
- **Municipal actors**
  - Building committee
  - Rescue service

Connections:
- Legislations to Project team
- Legislations to Municipal actors
- Building permit
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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