CRITICAL INFRASTRUCTURE RESILIENCE

- Comparing Swedish critical infrastructures based on interruption data

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WHAT IS RESILIENCE?

• Resilience (*from lat. resilio*)
  • Bounce back

• System/engineering resilience
  • The ability to cope with and recover from stress

• Within the narrow scope of engineering based resilience, often conceptualized as:
  • ‘Functionality’ over ‘time”

*from of Bruneau et al. (2003)

*from Hosseini et al. (2016)
**ACADEMIC CONTRIBUTION**

**General academic approaches**
- One type of infrastructure
- Single event, often large scale
- The data needed is difficult to achieve
- Functionality curves

**Our approach**
- Multiple infrastructures (generic)
- Multiple events, all magnitudes
- Required data is achievable
- Functionality curves
- Enables cross-infrastructural comparisons
The resilience assessment approach

Individual sub-infrastructures

Aggregation

The final ”national” data-set
The storm Gudrun in 2005
16% of Sweden’s electricity distribution customers without power supply, some for up to seven weeks.
The storm Simone

The storm Hilde

The storm Sven

The storm Ivar
## RESULTS AND DATA SUMMARY

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Resilience comparison Results</th>
<th>Year(s)</th>
<th>Raw Data</th>
<th>Treated Data</th>
<th>Consequences = 0</th>
<th>Usable in the approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity Transmission</strong></td>
<td>1</td>
<td>2005 - 2016</td>
<td>2 468</td>
<td>143</td>
<td>2 228</td>
<td>5.79%</td>
</tr>
<tr>
<td><strong>Water Supply</strong></td>
<td>2</td>
<td>2007 - 2017</td>
<td>3 466</td>
<td>1 685</td>
<td>462</td>
<td>48.62%</td>
</tr>
<tr>
<td><strong>Transport Road</strong></td>
<td>3</td>
<td>2016 - 2017</td>
<td>8 295</td>
<td>5 565</td>
<td>2 730</td>
<td>67.09%</td>
</tr>
<tr>
<td><strong>Telecommunication Broadband</strong></td>
<td>4</td>
<td>2011 - 2017</td>
<td>111</td>
<td>72</td>
<td>0</td>
<td>64.86%</td>
</tr>
<tr>
<td><strong>Telecommunication Fixed Telephony</strong></td>
<td>5</td>
<td>2011 - 2017</td>
<td>51</td>
<td>35</td>
<td>0</td>
<td>68.63%</td>
</tr>
<tr>
<td><strong>Telecommunication Mobile</strong></td>
<td>6</td>
<td>2011 - 2017</td>
<td>99</td>
<td>55</td>
<td>0</td>
<td>55.56%</td>
</tr>
<tr>
<td><strong>Electricity Distribution</strong></td>
<td>7</td>
<td>2005 - 2016</td>
<td>704 438</td>
<td>680 683</td>
<td>5 298</td>
<td>96.63%</td>
</tr>
<tr>
<td><strong>Transport Railway</strong></td>
<td>8</td>
<td>2012 - 2016</td>
<td>994 396</td>
<td>951 652</td>
<td>15 292</td>
<td>95.70%</td>
</tr>
</tbody>
</table>
CONCLUSION AND DISCUSSION

Strengths of the approach
- Multiple infrastructures (generic)
- Multiple events
- Required data is achievable
- Functionality curves
- Enable cross-infrastructural comparisons

- Risk Management
- Call for national interruption data initiative
- Ways forward
Thanks for listening!

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