Projekt- och resultatkonferens InfraSweden2030

Climate change impact on safety and performance of existing and future infrastructure

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INFRA SWEDEN 2030

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Projektpartner

LUNDS UNIVERSITET | LTH LUNDS TEKNISKA HÖGSKOLA | SMHI | RI. SE | SKANSKA

Behovsägare

Samhället

TRAFIKVERKET | Kommuner | Industriaktörer

Project tasks

1. Identify potential climate change impacts on bridges and review possible adaptation techniques.
2. Develop risk-based prioritization method.
3. Develop conceptual framework for bridge design considering climate change risks

DONE

4. Quantitatively assess (some of) the most critical impacts of climate change on bridges.

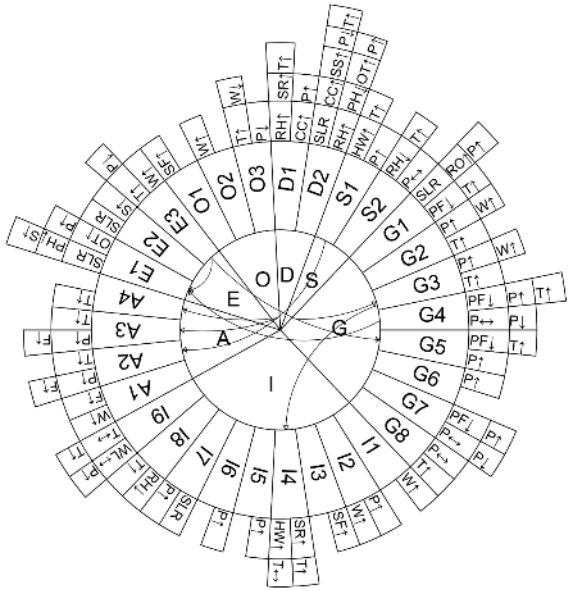
NOW

5. Study the cost-effectiveness of adaptation techniques for (some of) the most critical impacts of climate change on bridges.

NEXT

Implementation

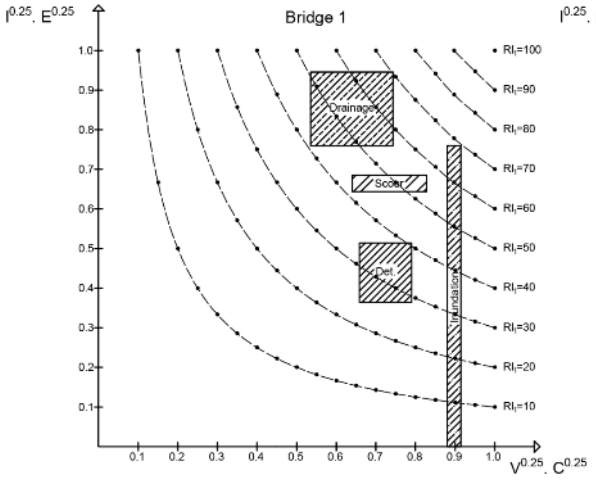
Results so far



Identified risks

R =	$P(H)$ ·	$P(E\|H)$ ·	$P(D\|E \cap H)$ ·	$C(D)$
Description	Hazard: The probability of a climatic hazard (e.g. increased storm activity)	Exposure: The probability of an adverse impact on the bridge as a result of the hazard (e.g. increased storm surge heights)	Vulnerability: The probability of a damage resulting from the increased hazard and exposure	Consequences: The consequences of such a damage
Possible risk management measures	Reduction of GHG emissions (by e.g., introducing more strict regulations, reducing VMT through land use and urban planning strategies, etc.)	Regional adaptation measures, e.g.: • Storm surge barriers • Improved land use planning (e.g. relocation)	Local adaptation measures, e.g.: • Increase bridge elevation • Insert holes in the bridge superstructure • Improve span continuity • Use tie-down, restrainers, or anchorage bars	Adaptation measures for reducing cascading effects: • Increase robustness • Increase network redundancy • Improved emergency planning and disaster preparedness • Improved understanding of the interdependencies between different infrastructure
	Climate change mitigation	Climate change adaptation		

Adaptation



Prioritization

Discussion points

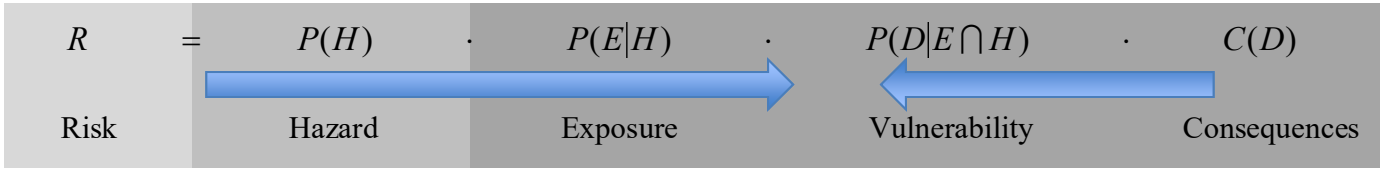
- Implementation of current results for infrastructure owner?
- Ongoing & future project tasks in this project
  - Risk quantification
  - Designing bridges (infrastructure) for climate change
- Future challenges & opportunities
  - Resource expenditure – bridge vs road/rail vs society
  - Future risk acceptability considering climate change
  - Time perspectives

Implementation of results so far

- Risk identification→ Improve risk awareness & understanding
- Risk prioritization→ Which risks relevant for one bridge (or which bridge is more critical among a population of bridges)
- Design → Decision support for design strategies

Ongoing & future work

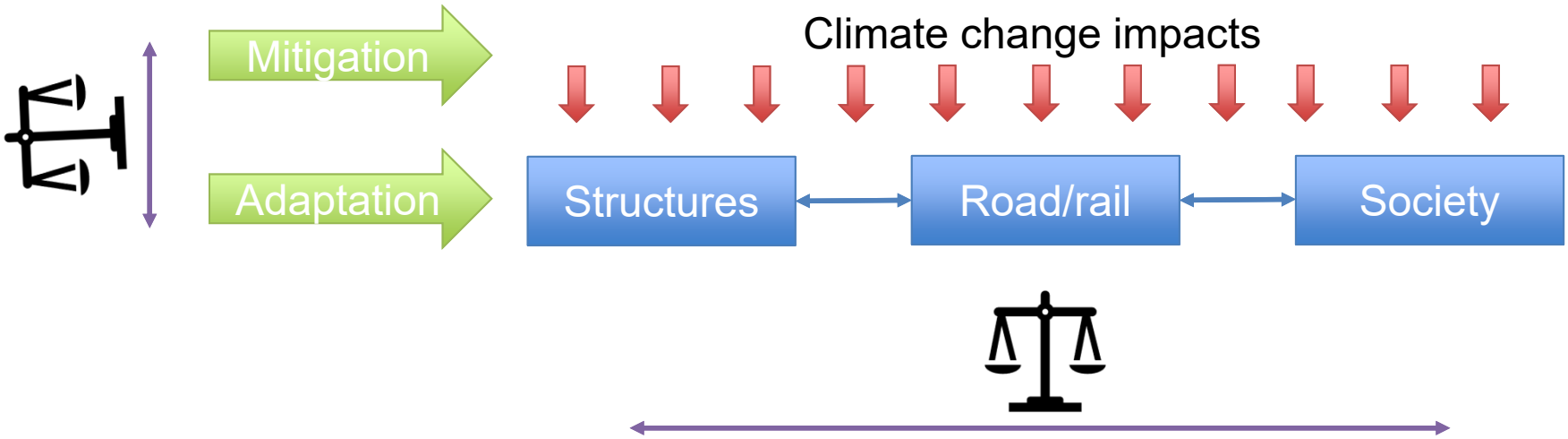
- Risk quantification – combine climate impacts with vulnerability & consequence



- Adaptation techniques for selected risks – if risk is critical for selected bridge, what can we do about it?

Future challenges & opportunities

- Resource expenditure & distribution for climate change adaptation & mitigation?



Future challenges & opportunities

- Risk acceptance considering future climate situation?
  - Criteria based on indicators which may alter as a result of climate change – what are we willing to accept in 20, 50, 100 years?

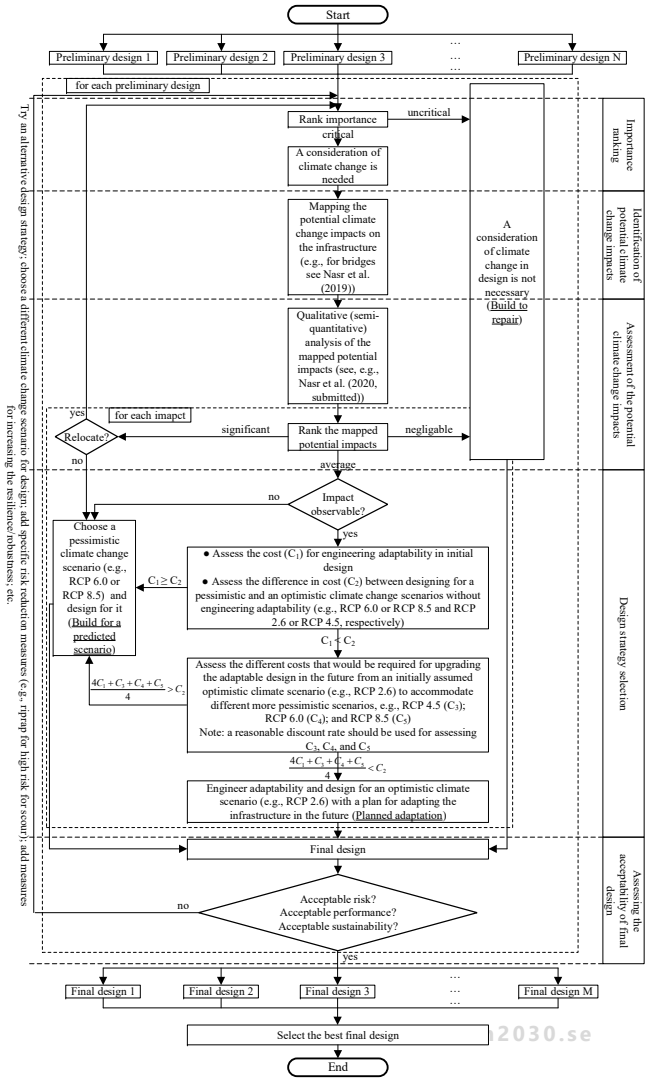
- Time perspectives – what reference time is relevant and how can this be determined?
  - Bridge obsolesce
  - Technological innovations / developments
  - Etc.

Other…

Some specific ongoing work

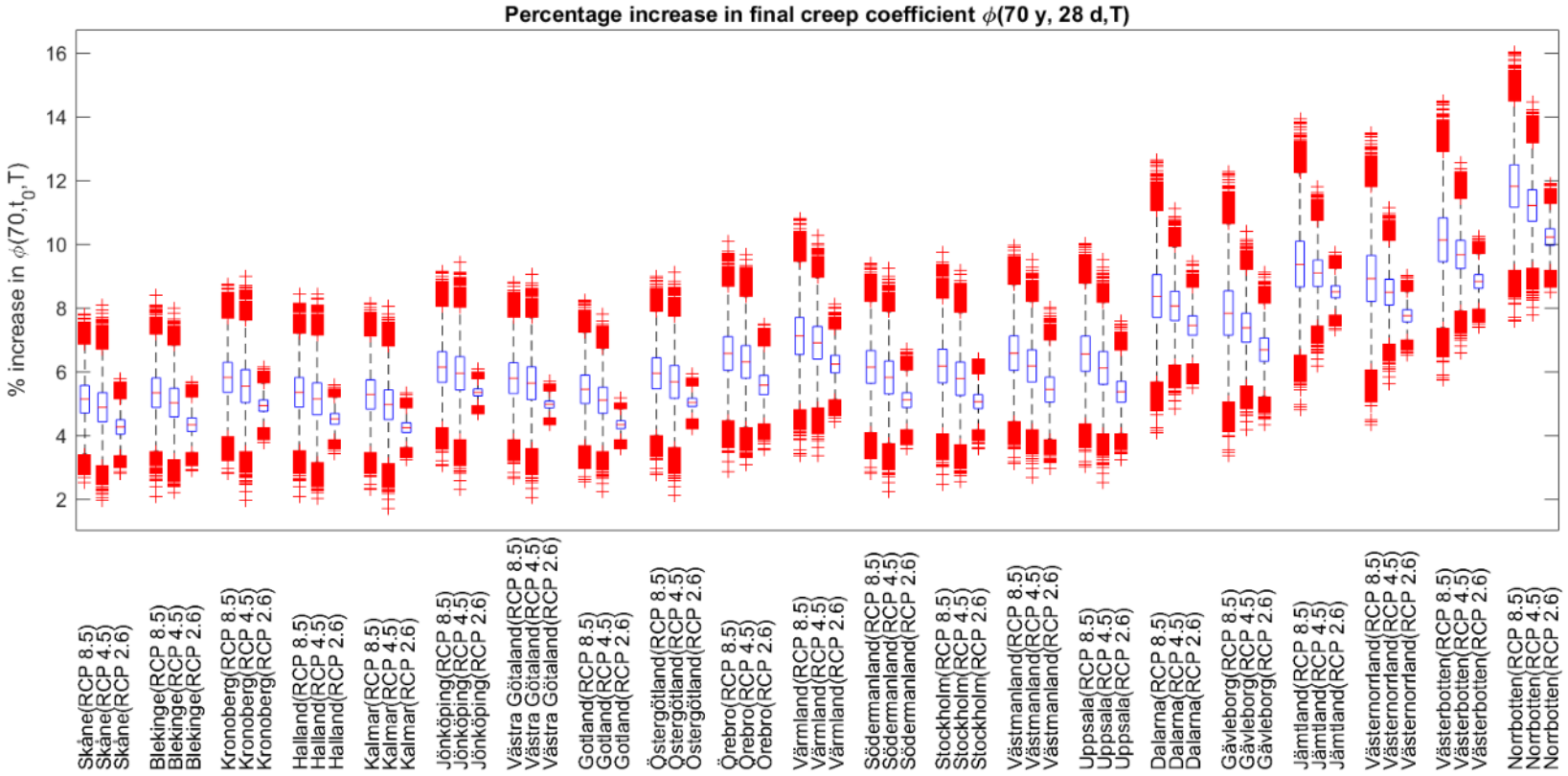
Design for climate change

- Developing a conceptual framework for the design of infrastructure in a changing climate with the following 5 stages:
  - Importance ranking
  - Identification of potential climate change impacts
  - Assessment of the potential climate change impacts
  - Design strategy selection
  - Assessing the acceptability of the final design



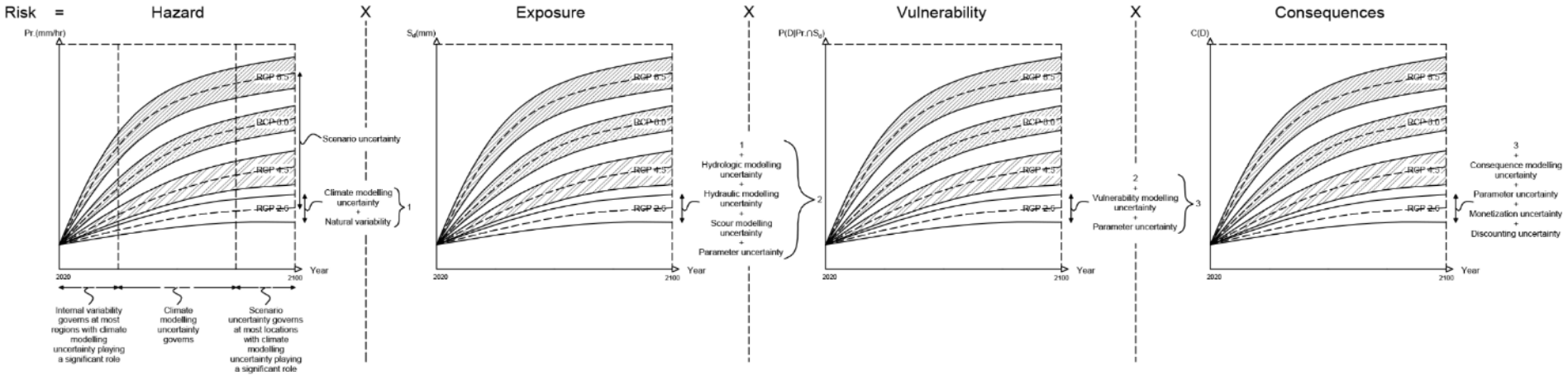
In-depth risk quantification

- Quantifying the impact of climate change on the creep of concrete



In-depth risk quantification

- Characterizing climate change impact uncertainty.



Selected publications from project

Nasr, A., Björnsson, I., Ivanov, O. L., Johansson, J., Honfi, D., & Kjellström, E. (2019). A review of the potential impacts of climate change on the safety and performance of bridges. *Sustainable and Resilient Infrastructure*. doi: 10.1080/23789689.2019.1593003 (https://www.tandfonline.com/doi/full/10.1080/23789689.2019.1593003)

Nasr, A., Kjellström, E., Björnsson, I., Honfi, D, Ivanov, O. L., & Johansson, J. (2019). Bridges in a changing climate: A study of the potential impacts of climate change on bridges and their possible adaptations. *Structure and Infrastructure Engineering*. doi: 10.1080/15732479.2019.1670215 (https://www.tandfonline.com/doi/full/10.1080/15732479.2019.1670215)

Nasr, A., Björnsson, I., Honfi, D., Ivanov, O. L., Johansson, J., & Kjellström, E. (Submitted Manuscript). Risk-based prioritization method for considering the effects of climate change on bridges. *Manuscript submitted for publication*

Nasr, A., Ivanov, O. L., Björnsson, I., Honfi, D., Johansson, J., & Kjellström, E. (2019) Klimatförändringars inverkan på broars säkerhet och prestanda : En översyn av potentiella effekter och anpassningsåtgärder. TVBK 3072. Division of Structural Engineering, LTH. (https://lup.lub.lu.se/search/publication/3f8c0a3c-7e2c-42e5-bc42-4f71f0ec43da)