Open Research Day

9 April 2025

13:15-13:50

Parallel Sessions- *lightning talks followed by breakout session*

A108: Digitalized Built Environment I

Chair: Professor David Broman, KTH

A123: Digitalized Health Care I

Chair: Professor Hercules Dalianis, Stockholm University

A108: Digitalized Built Environment I

- Lightning talk: Session chair: Professor David Broman, KTH

1. Towards smart water-Democritus impact project (CP Impact)
2. Barriers and enabling factors for digitalisation in the Swedish water sector (SI)
3. DECORUM Optimized predictive maintenance for wastewater pump stations (SI)
4. Towards Safe Smart Construction: Algorithms, Digital Twins and Infrastructures (II)

Towards Smart Water- Democritus

Michele Mascherpa – KTH / Department of Mathematics
Victor Molnö – KTH / Division of Decision and Control Systems

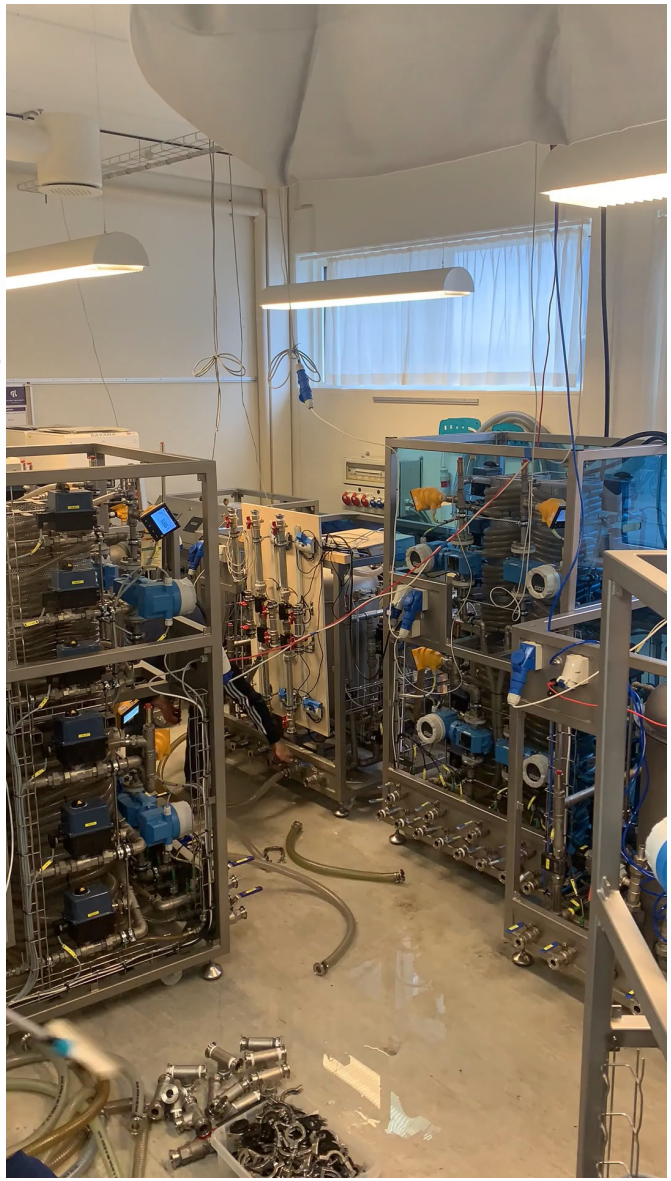
Leakage & Pollution in Water Networks: Theory & Experiments

Water firms in England and Wales lost more than 1tn litres from leaks last year

Trillions of gallons leak from aging drinking water systems, further stressing shrinking US cities

2024-10-13 05:21 Uppdaterad 2024-10-13 07:29

Inbrott i vattentorn i Bollnäs – uppmanas koka vatten



- Leakage localization in different setups
- Pollution estimation with sensors and Optimal Transport based method
- Experiments at SWIL Laboratory in Aalborg

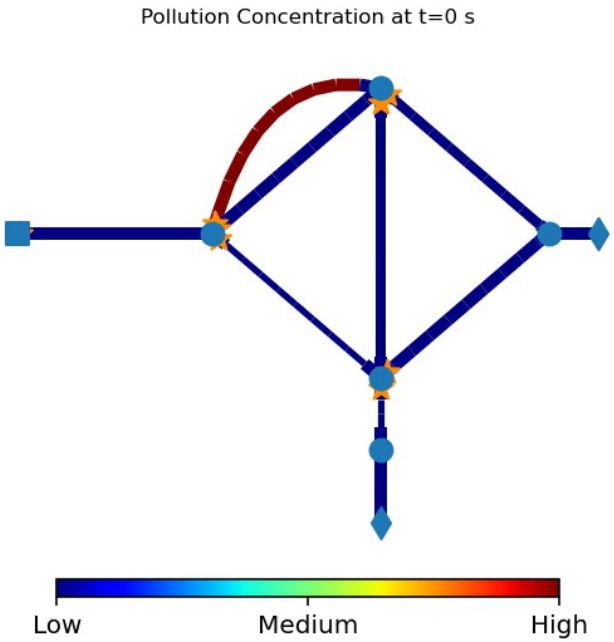
Pollution Estimation

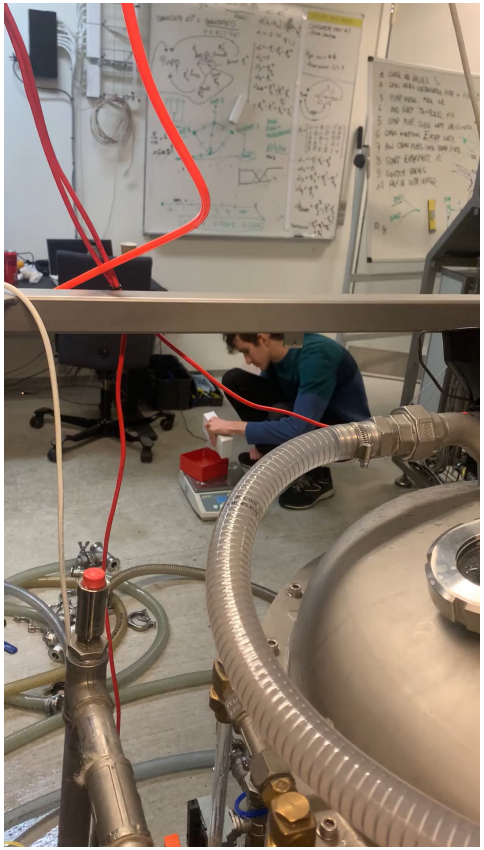
- Water quality measurements available in some points
- Use flows estimates to build Markov model $\boldsymbol{A}$ for pollution flow
- Find pollution transport matrix $\boldsymbol{M}$ minimizing entropy D

$$\min \sum_t D(M^t | A^t)$$

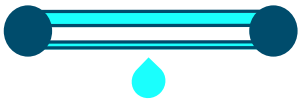
$$\text{s.t } mass\ is\ conserved$$
$$sensor\ measurements\ matched$$

- Efficient method for solving it

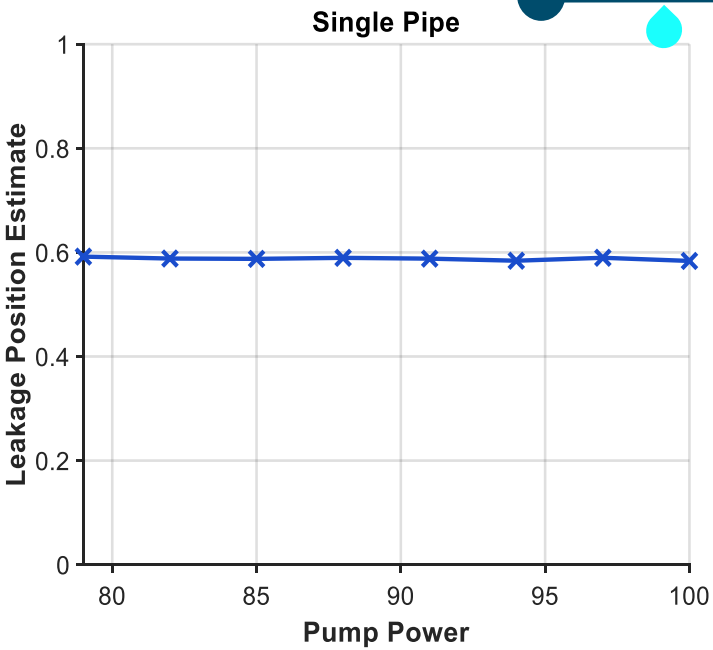




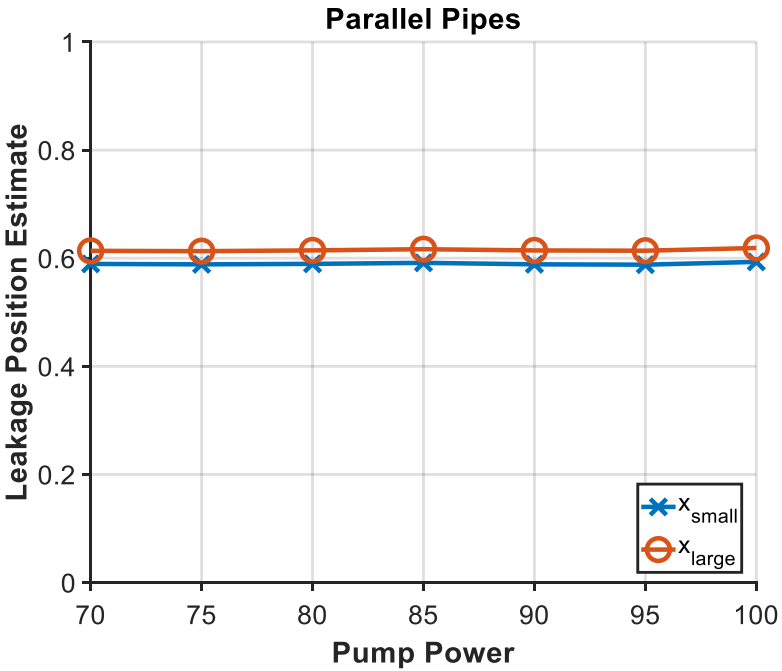
Leakage Localization



Single pipe leak easy to localize given model



Parallel pipes can be difficult to distinguish



Thank you

Barriers and Enabling factors for digitalisation of the Swedish water sector

David Nilsson (PhD, Docent), Framverket, affiliated scholar

Mats Engwall & Maksim Miterev, KTH

Pär Blomkvist, Mälardalen University

Water utilities are special

Critical societal infrastructure

Public monopolies

Mainly old infrastructure

High-Reliability Organisations

Limited R&D capacity

Digitalisation since 1980s

Photo: Aveki AB

How to make digital innovation happen

- **Collaborative innovation**
- Value for operations
- Simple and easy to use
- Reliable
- Modular
- "Fiery souls"

Miterev, Blomkvist & Nilsson (2025). Breaking out of the straightjacket. Facilitating digital innovation in resource-constrained high-reliability organizations. IPDMC, Portugal, 11-13 June.

Thank you

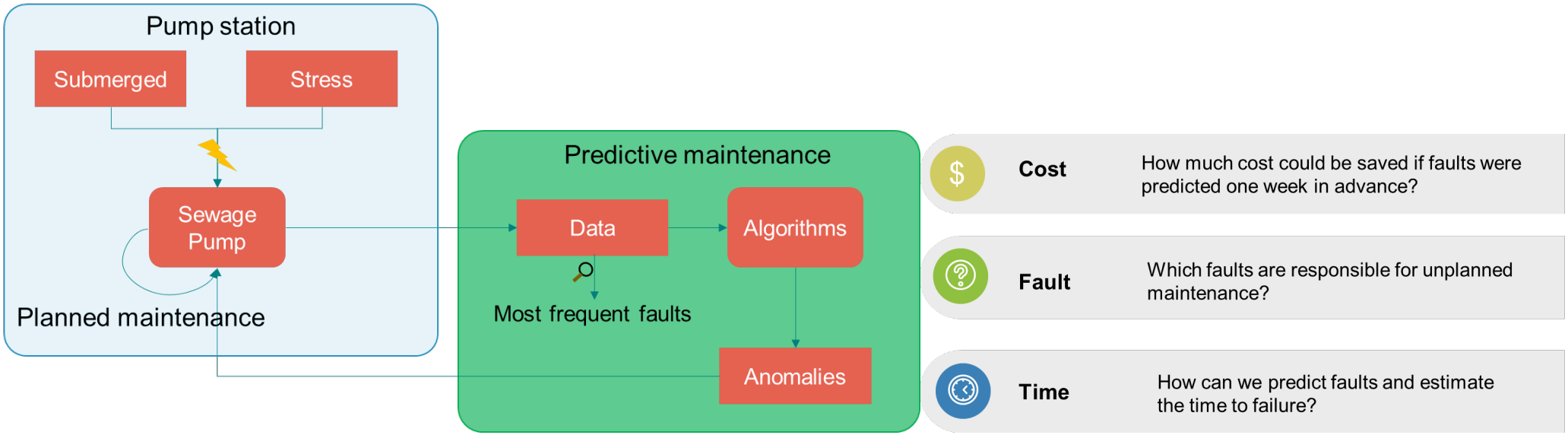
DECORUM: Optimized predictive maintenance for wastewater pump stations

Project DECORUM

PI: Matthieu Barreau

Co-PI: Henrik Sandberg, Ulf Carlsson, Ivar Nöre, Anders Broberg

DECORUM project



Problem Definition

3. Robustness

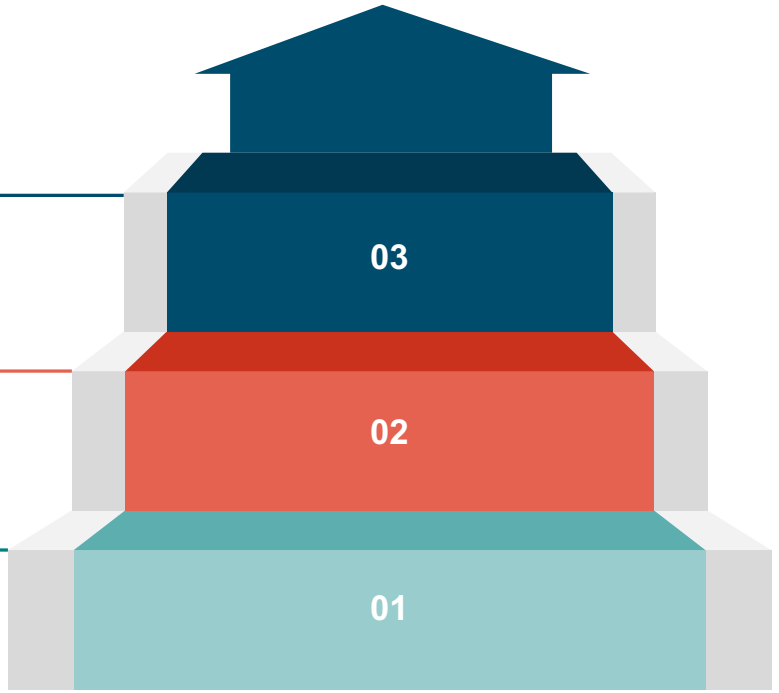
How can we ensure the model's robustness for other pumps, considering varying operating conditions, equipment age, and other factors?)

2. More Measurements

What additional measurements could be considered?

1. Current Measurements

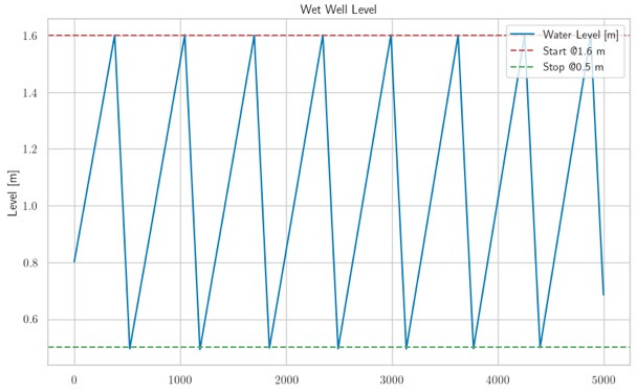
What measurements are currently available to us?

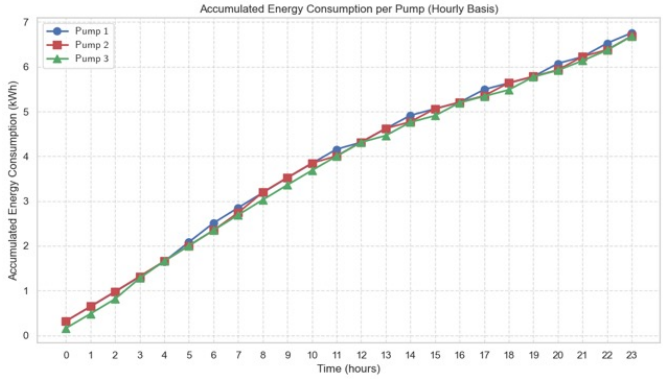


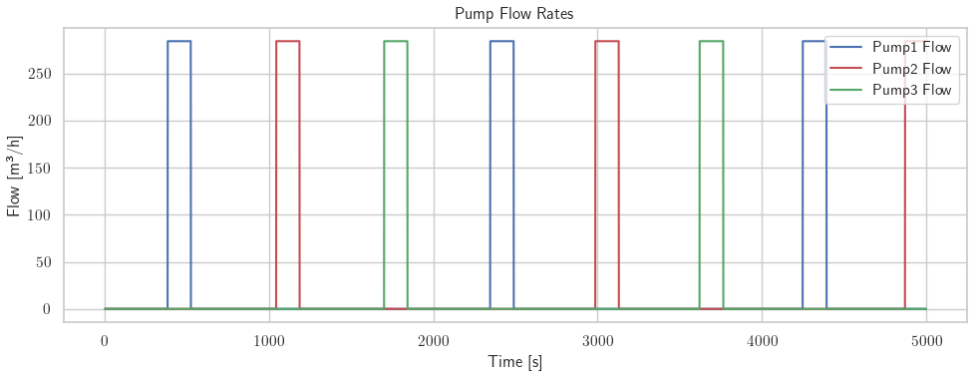
Key Milestones in DECORUM Project

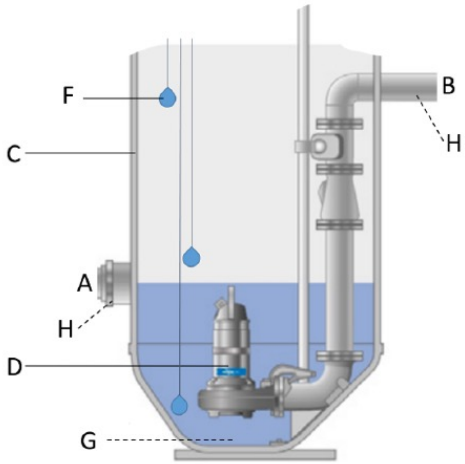
	Requirements	Expected Output	Method
Step #1	Nominal Data	Health monitoring, identify anomalies (Faults already happened)	Encoder-Decoder
Step #2	Failure Data Expert Knowledge	Determine which failures happen	Simulator and Classification Algorihms
Step #3	Time Series Labeled Dataset	Predict time to failure	Hidden Markov Model

Pump Simulator: A Key Tool for Maintenance









Thank you

Towards Safe Smart Construction: Algorithms, Digital Twins and Infrastructures

Mani Dhullipalla
EECS, KTH Royal Institute of Technology

Project partners: KTH, Skanska, Ericcson,

Construction ..... Today

Extensive manual intervention

- Safety risks for personnel
- Difficulty to maintain/control quality of outcome

Low degree of automation

- Hard for real-time monitoring
- Slow production cycle

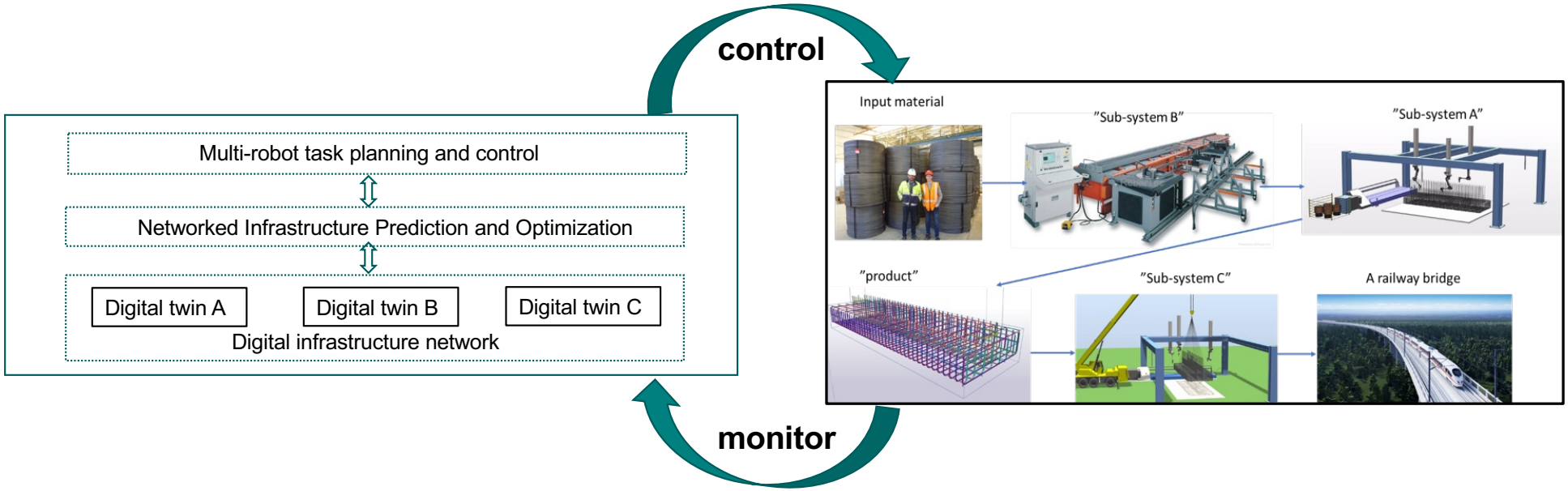
High carbon emissions

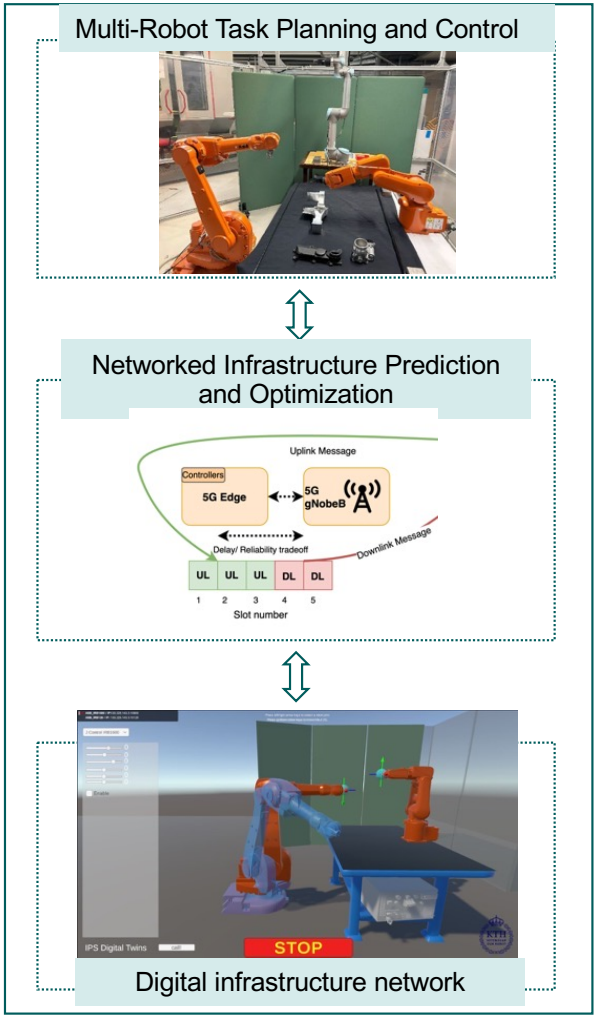
- Mobility & operations

Smart Construction ..... Tomorrow

Vision: fully digitalized and automated value chain

Skanska case: a multi-system set-up for onsite production of **REINFORCEMENT CAGES**





Tomorrow

Robots for automation:

Cooperative & safe planning and control algorithms under communication constraints.

Networks for remote operation:

Negotiate communication & computation grants between 5G/B5G network and robots.

Digital twins to mimic & monitor:

Digital twin for remote real-time monitoring and control of multi-robot systems.

Thank you

digital futures

PARTNERS

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