

# TRANSFORMATIVE HIGH RISK PROJECTS

- **INTEGRATION OF CLIMATE CHANGE IMPACT /CLIMATE CHANGE ADAPTATION IN OPERATION AND MAINT PLANNING**
- **AI EMPOWERED MAINTENANCE & INSPECTION REGIME AND DIGITAL INSPECTION & INSPECTION IN METAVERSSE**
- **LIFE CYCLE MANAGEMENT /LIFE EXTENSION – MAINTENANCE & SUPPORT LOGISTICS**

# LIFE CYCLE MANAGEMENT

- Macro level
- Micro Level

Technical –Financial – Societal

Life Extension

Technology Driven Life Extension

Business Driven Life Extension

Drivers, Barriers and Enablers

# Achieving designed service life and restoration of compromised capacity

## The Main Research Questions:

What systems, sub-systems or components among infrastructure are affected by aging?

What is meant by aging?  
What are the dominant failure mechanisms that promote aging of infrastructure?

What are the dominant failure modes due to aging of infrastructure?

What are the metrics for aging for different elements of railway infrastructure (performance, function, etc)?

How does aging affect service life, functionality, and availability?

What are the existing life limited Parts in railway infrastructure, and what are the basis for their life definition?

What happens to the defined life limit, when the demand changes

Which items are more significant for life extension program?

What are the consequences of aging?

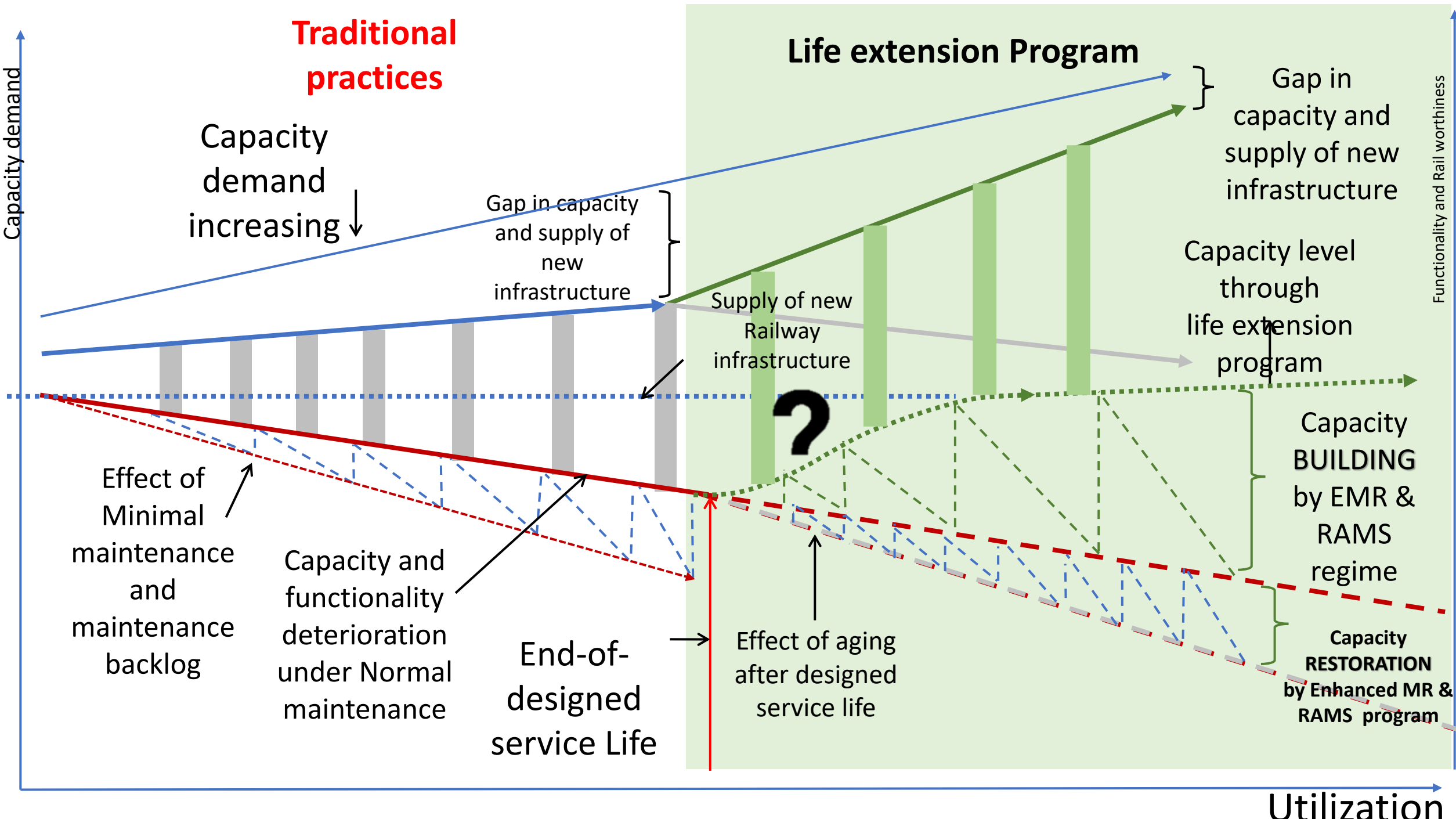
What are the current practices that reduce the deterioration rate of railway infrastructure?

What is the role of emerging engineering paradigms in addressing aging infrastructure (performance-based considerations, resiliency, multi-hazards, etc.)?

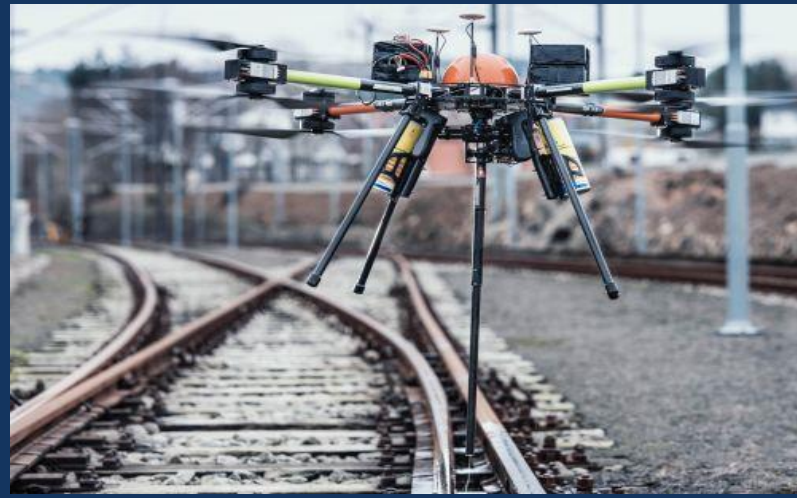
How does obsolescence and introduction of modern technologies affect decision-making

# The prime challenges of service life extension

- How to overcome **Reliability/Resilience/Endurance deterioration**
  - due to over utilization
  - due to maintenance backlog
  - due to premature aging
  - due to climate change/ natural disaster



# DIGITAL INSPECTION DOGS, DRONES AND DIGITAL TWINS





# ROBOT DOG BEING TRAINED IN LAB



Robot dogs fill capability gaps and provides deeper **HEALTH** insight

*Potentially a new best friend for Railway maintenance personnel in the field*

- Remote & Digital inspection
- Autonomous mission





**ROBOT DOG BEING TRAINED  
ON TEST TRACK @JVTC - LTU**

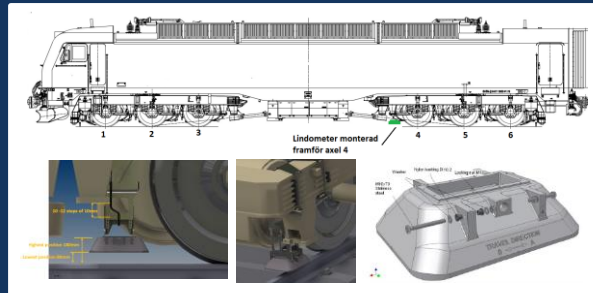




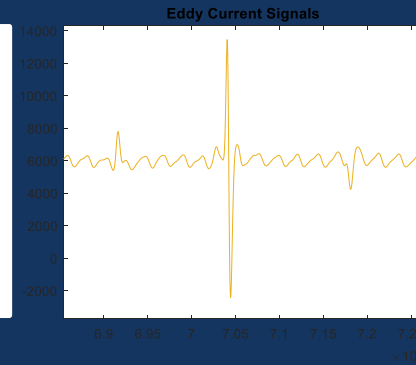
# DIGITAL INSPECTION



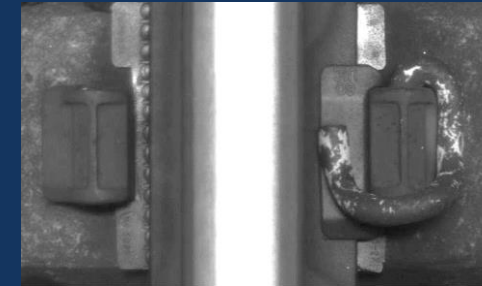
Sensor on In-service trains



Insulation joint



Combine acceleration and magnetic signatures with images (Digital inspection project)

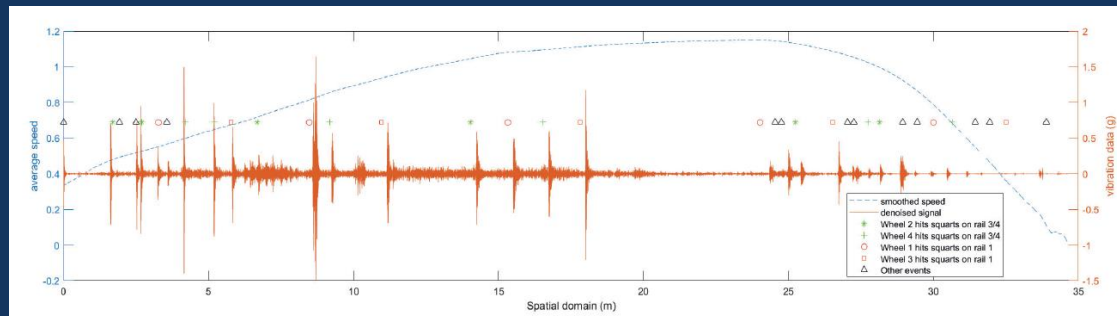


# DIGITAL INSPECTION



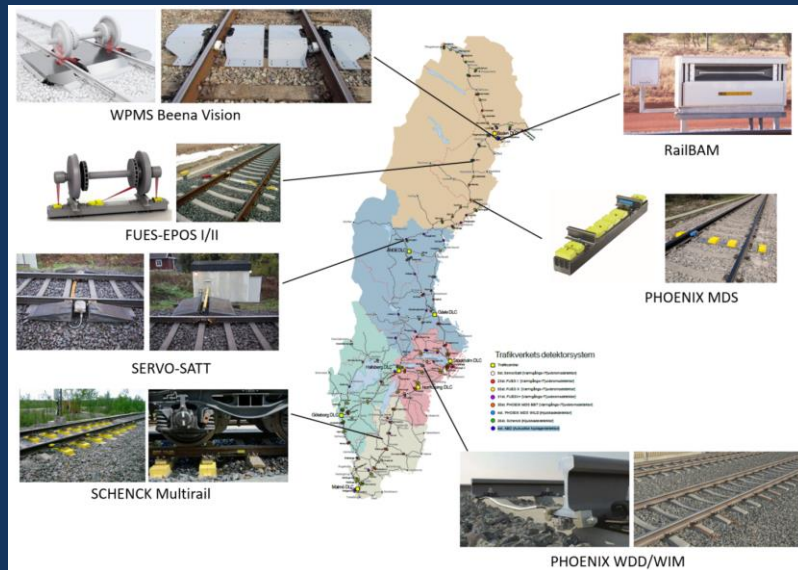
Condition monitoring of S&C's  
Defect detection

Combine with point machine monitoring

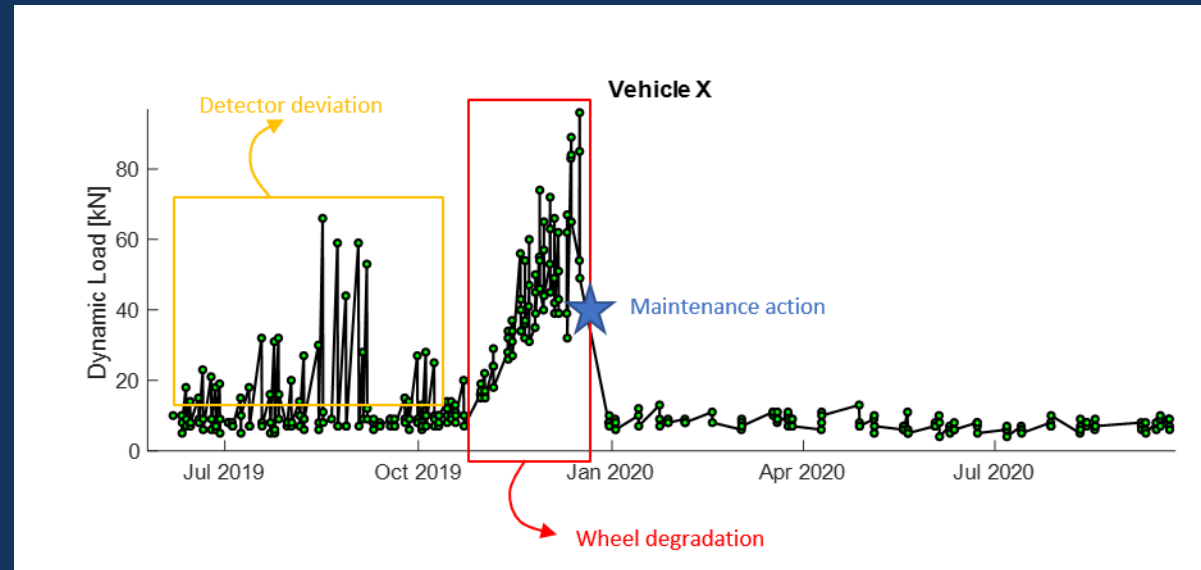


# WAYSIDE DETECTOR FOR VEHICLE AND TRACK CBM

## Wayside detectors



## Vehicle status prediction - Impact detector







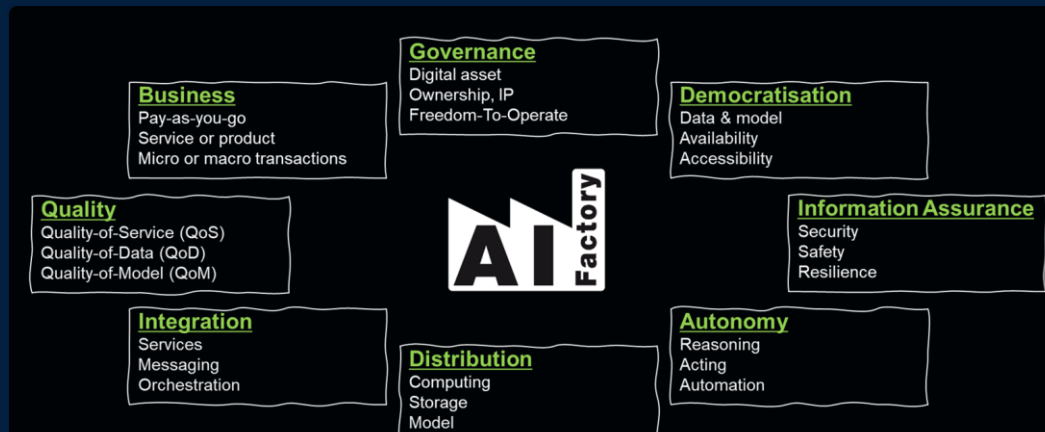


Metaverse for railway assets (MR)

# AI FACTORY

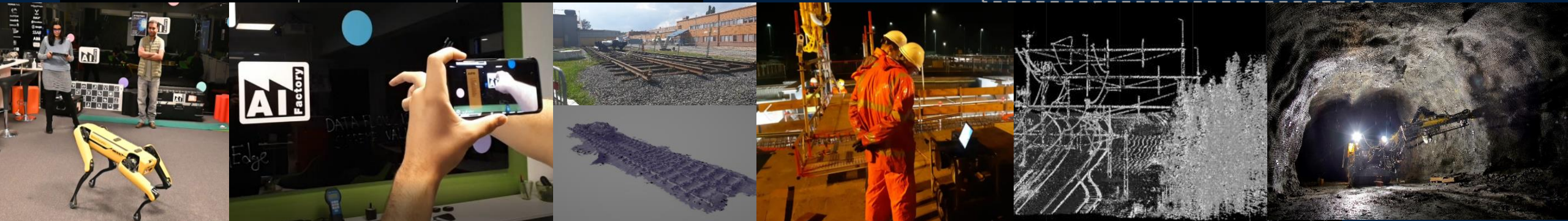
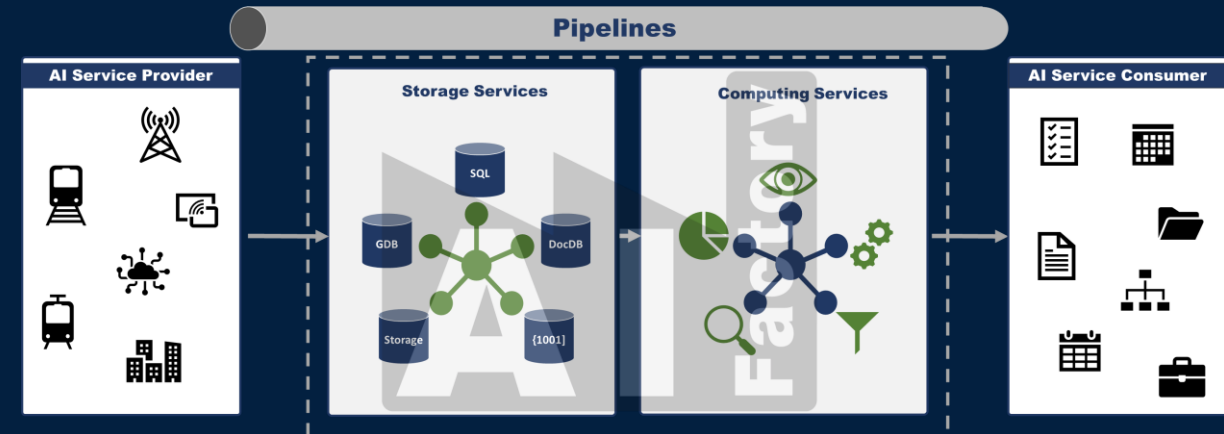
## Research Concept

- **WHY** things need to be done!



## Technology Platform

- **HOW** things can be done!

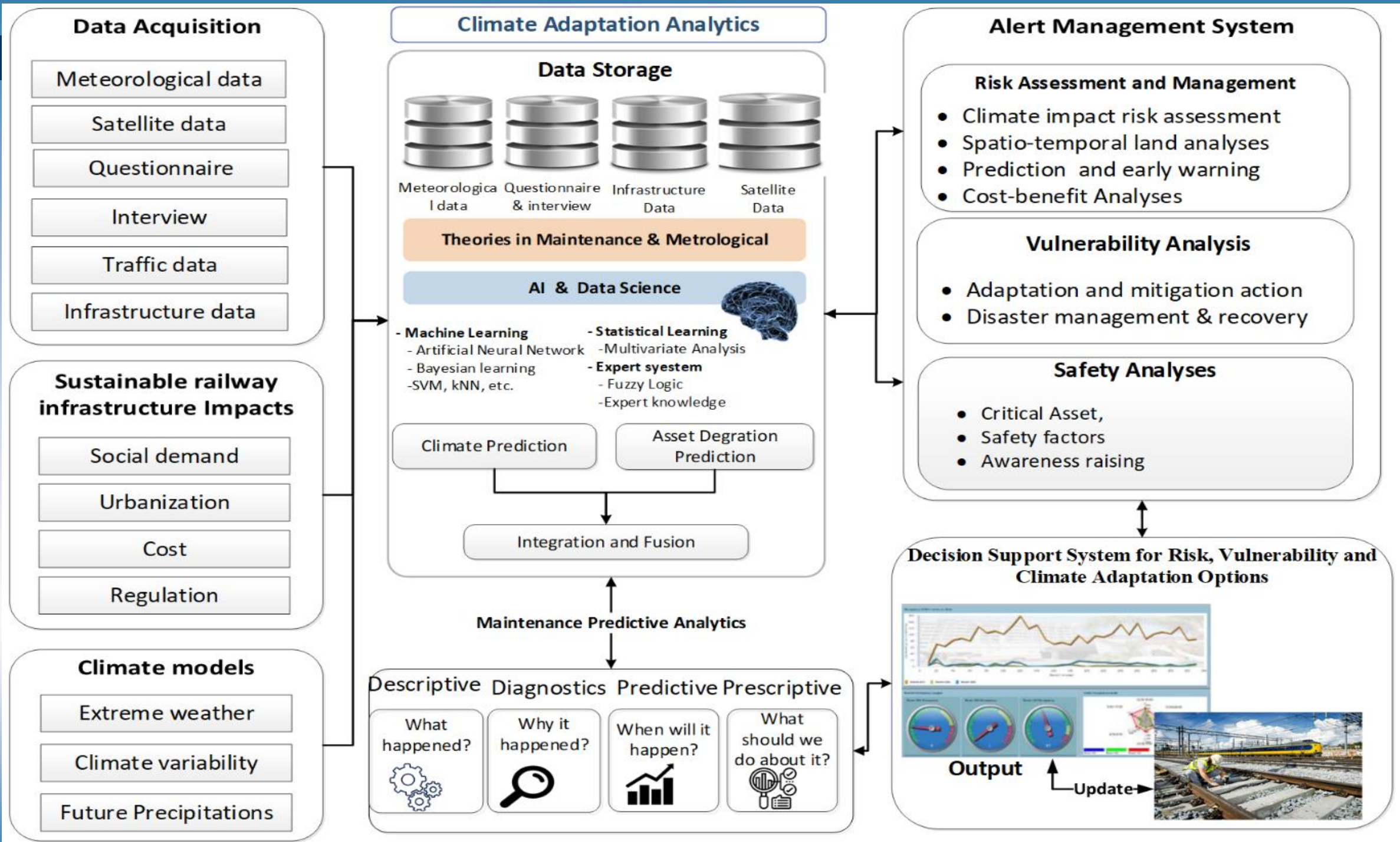






Examples  
Climate Impacts On  
Swedish Transport  
Network  
August 2023







THE NORTHERNMOST UNIVERSITY  
of Technology in Scandinavia



**TACK**