PONSSE EPEC FORWARD’27 EKOSYSTEEMIWEBINAARI

7.2.2025

FORWARD '27

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AN ECOSYSTEM PROGRAM BY PONSSE GROUP

PONSSE EPEC FORWARD’27 EKOSYSTEEMIWEBINAARI
Toimintaohjeet

- Mikit pidetään mykistettyinä
- Webinaari tallennetaan
- Q&A lopussa

- Tervetuloa seuraamaan Ponsse Epec FORWARD’27 webinaaria!

PONSSE EPEC FORWARD’27 EKOSYSTEEMIWEBINAARI
Agenda

13:00 Tervetuloa ja toimintaohjeet, Agenda

Co-Innovation -projektien esittely:

13:05 VIIMA: *Antti Ahola*, dosentti, LUT-yliopisto
Kommentaattori *Jussi Immonen*, Engineering Manager, Simulations & Verification, Ponsse R&D

13:20 DRIVE FORWARD: *Jari Vepsäläinen*, apulaisprofessori, Aalto yliopisto
Kommentaattori: *Kalle Einola*, Director, Research & Programs, Ponsse R&D

13:35 MIXER: *Petri Piippo*, projektipäällikkö, Tampereen yliopisto
Kommentaattori: *Panu Johansson*, Manager, UX, Systems & Connectivity, Ponsse R&D

13:50 Q&A

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VIIMA – VIRTUAL MATERIAL MANUFACTURING

Business Finland Co-Innovation Project

Antti Ahola
D. Sc. (Tech.), Adj. Professor (Docent)
Research Group of Steel Structures
LUT University

VIIMA – VIRTUAL MATERIAL MANUFACTURING

Duration: 01/2024 – 12/2026 (3 years)

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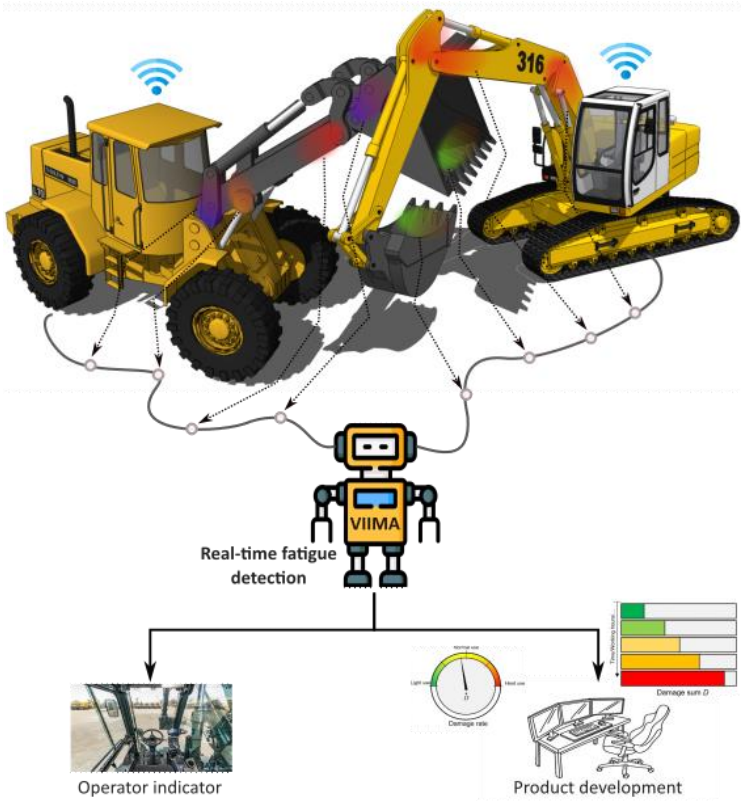
Problem statement

- **New materials** are not fully exploited in national low-volume and high-tailored products
- Fatigue assessments are based on statistical & history-based loading information thus preventing radical innovations in new products (remote-operated, autonomous machines)
- **Accurate fatigue estimation** requires high number of sensors at close location of critical structural details

Main objectives

- Development of real-time fatigue assessment system(s)
- Utilize simulation (e.g. real-time) to generate loading history with new machinery (data driven simulation)
- Seek business values related to green and electrification



OVERVIEW ON VIIMA TECHNOLOGY

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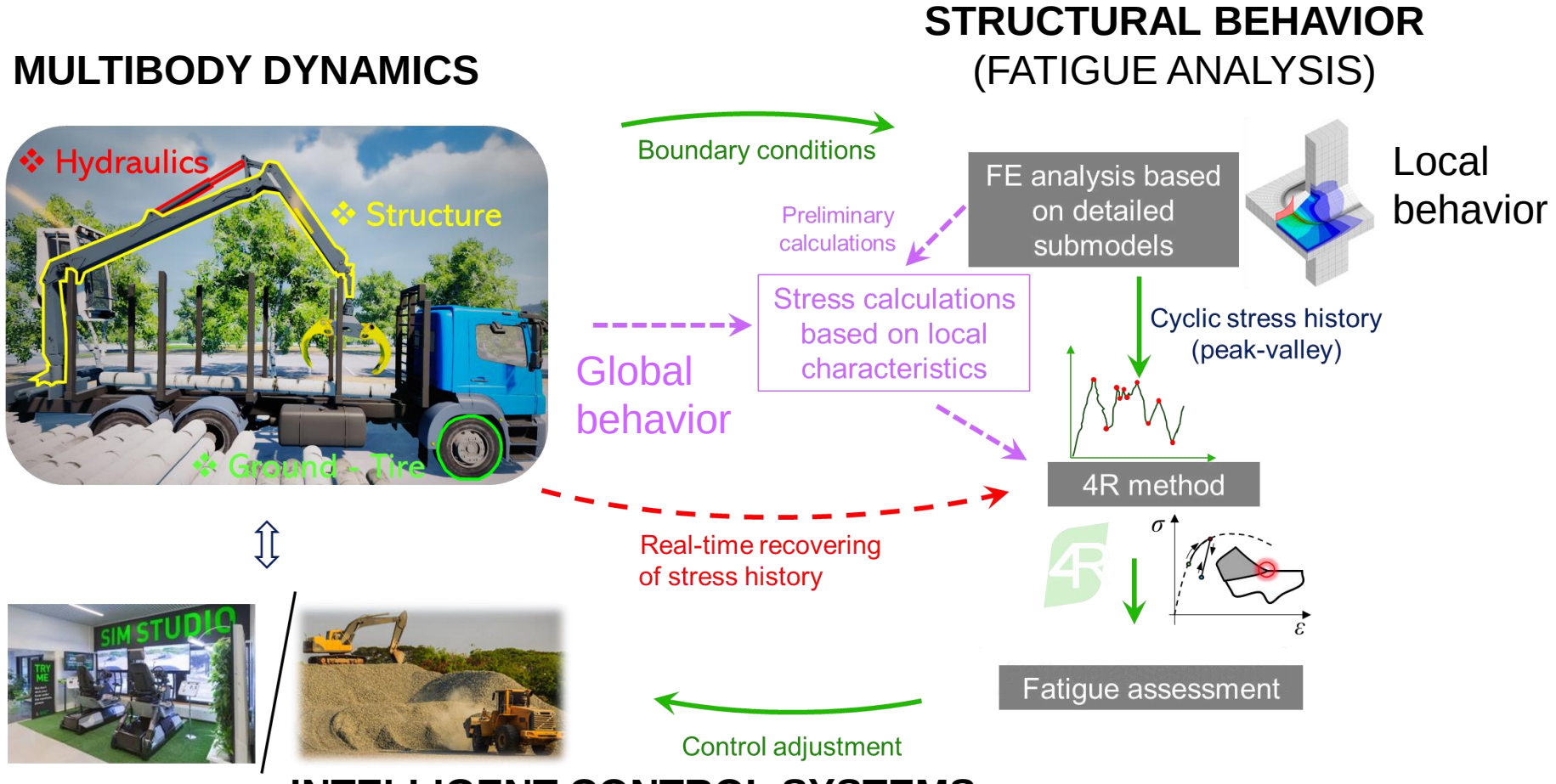
Simulation framework in VIIMA



VIIMA – RESOURCES

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Research groups

- Prof. Aki Mikkola (LUT Machine Design)
- Prof. Heikki Handroos (LUT Intelligent Machines)
- Dr. Antti Ahola (LUT Steel Structures)
- Dr. Antero Kutvonen (LUT Industrial Engineering and Management)
- Prof. Paavo Ritala (LUT Business School)
- Prof. Emil Kurvinen (University of Oulu, Machine Design)

Total budget

- Research organizations 1.9 M€
- Companies 3 M€

Project duration

- 01/2024 – 12/2026, 3-year project

VIIMA – ECOSYSTEM

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BUSINESS FINLAND

Research organizations

LUT University

OULUN YLIOPISTO

Companies (own projects)

FORWARD'27 PONSSE

ZERO4 KONECRANES

SHIFT'25 SANDVIK

IONCOR

STALA TUBE

Mevea Simulation solutions

In-kind companies (follow up)

DASSAULT SYSTEMES

RAND FINLAND SIMULATION SOFTWARE

Junttan respecting ground

EDR MEDESO

SIX Sustainable Industry X MOBILE WORK MACHINES

Thank you for your kind attention!

Aalto University
School of Engineering

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DriveForward

A FORWARD’27 project

Improving energy efficiency and efficiency of design.

Principal Investigator
Prof. Jari Vepsäläinen
Aalto University

Agenda

Motivation

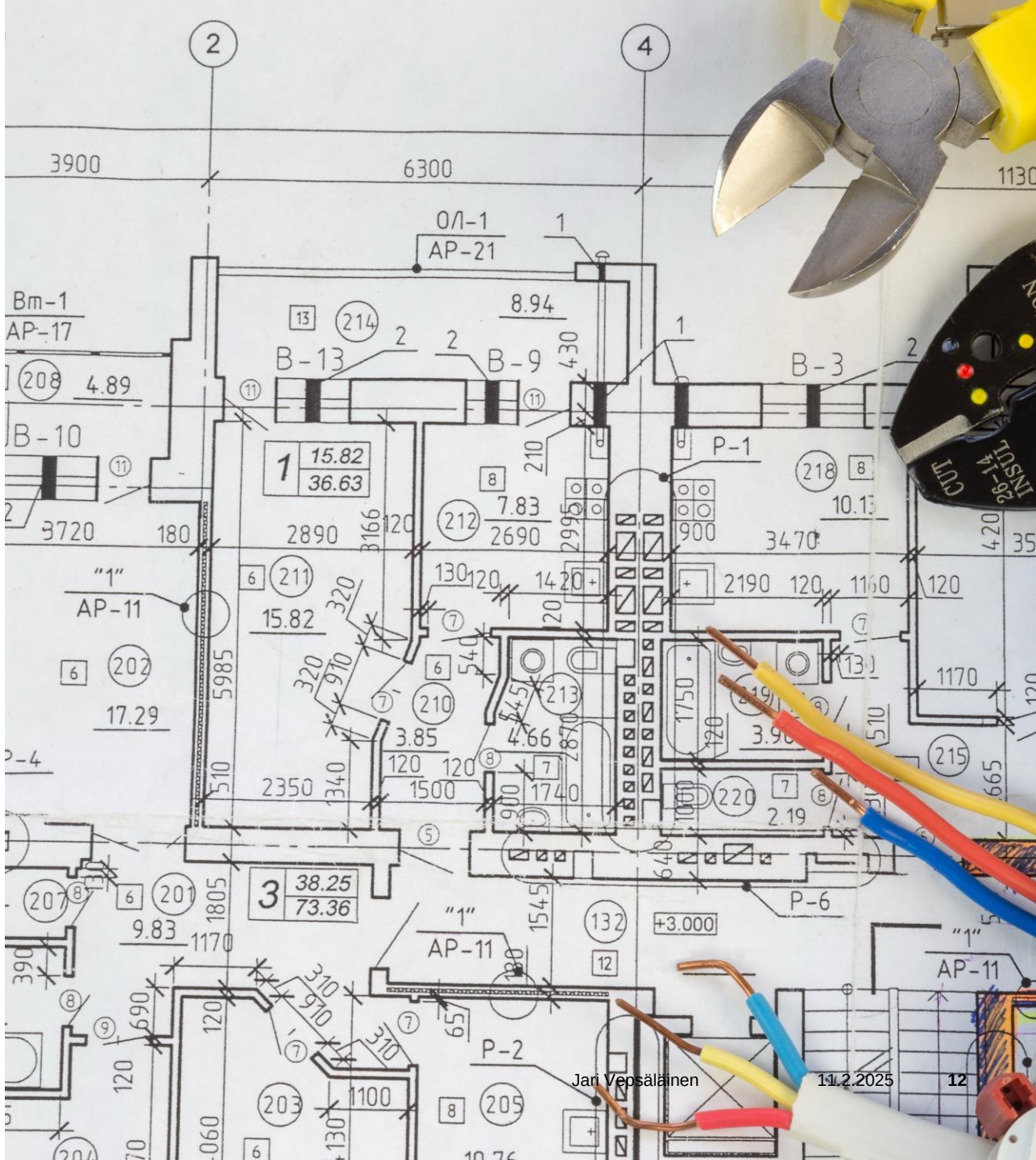
Project Goals

Resources

Budget & Schedule

Research

A!



Motivation

There is a need for electrification to reduce emissions and improve efficency. High power requires large batteries and motors. Challenges:

- Cost
- Weight
- Space
- Heat
- Design

What is this project about?

1. Making *mobile machines* more energy efficient
2. Minimizing costs and size of components
3. Large-scale experiments
4. Improving the design process

Mobile Machine Manufacturers

Service Providers

Energy Efficient Mobile Machines

Component and System Manufacturers

Research Organizations

Project overview

BF Co-innovation project (14 companies)

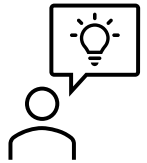
Total budget ~ 5 M€

- Public Research ~ 2.45 M€ (Aalto 1.67 M€ and TAU 0.78 M€)

Expectations

- 7 Doctoral theses
- 8 MSc theses
- Novel validated solutions
- Open source tools for design & analysis

Schedule (2024-2027)



Year 1: Ideation

Literature review

Novel concepts

Simulations

Preparation of test setups

Year 2: Iteration

Refining concepts

Advanced computations

Testbench calibration

Experiments

Year 3: Finalization

Comparison of solutions

Validation

Ready-to-use tools

WP1: Linear Actuation Design

WP2: Downsizing Components

WP3: Experiments and Validation

WP4: AI assisted Design

WP1: Preliminary Results

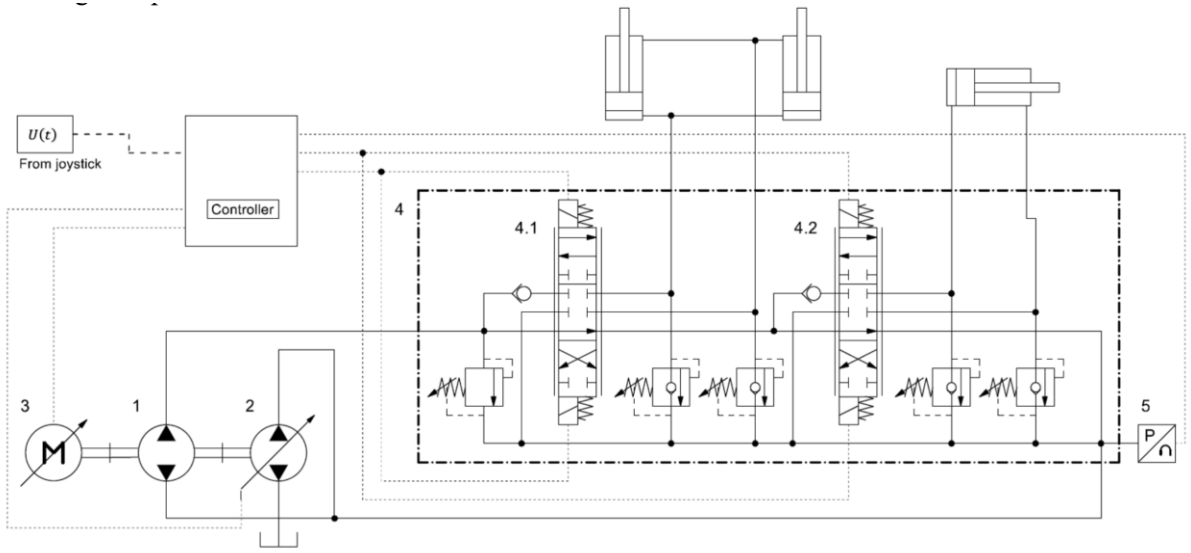


Figure 2. The presented OC-DC circuit for wheel loaders bucket system

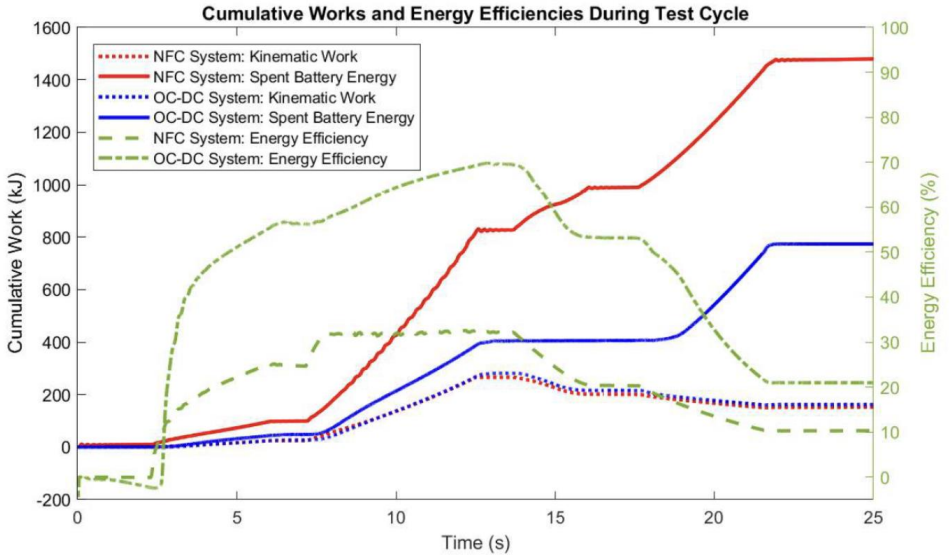
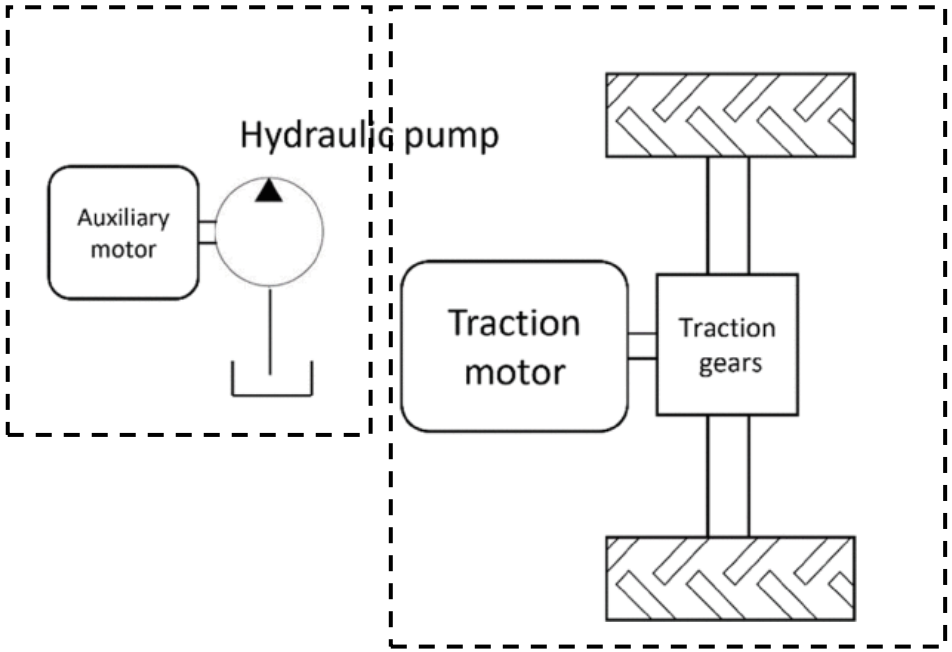


Figure 6. Spent battery energy, cumulative kinematic work and momentary energy efficiency of both OC-DC and the NFC system.

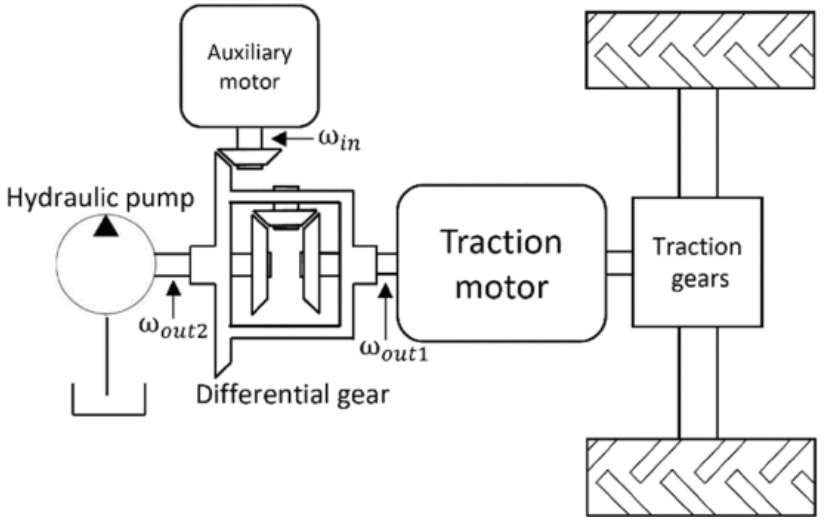
Utilizing the potential energy of one actuator to power another – Open Center Displacement control
Introducing coupled motors
➔ Improved efficiency +45% compared to Negative Flow Control (NFC)

Lehto, J., & Vepsäläinen, J. (2024). Displacement Control for Electric Motor Driven Open Center Mobile Hydraulics. In The 12th JFPS International Symposium on Fluid Power JFPS International Symposium on Fluid Power.

WP2: Preliminary Results



Electric mobile machine
Separate working hydraulics and traction



Introducing coupled motors
➔ Reduction of traction motor size with minor cost of energy efficiency

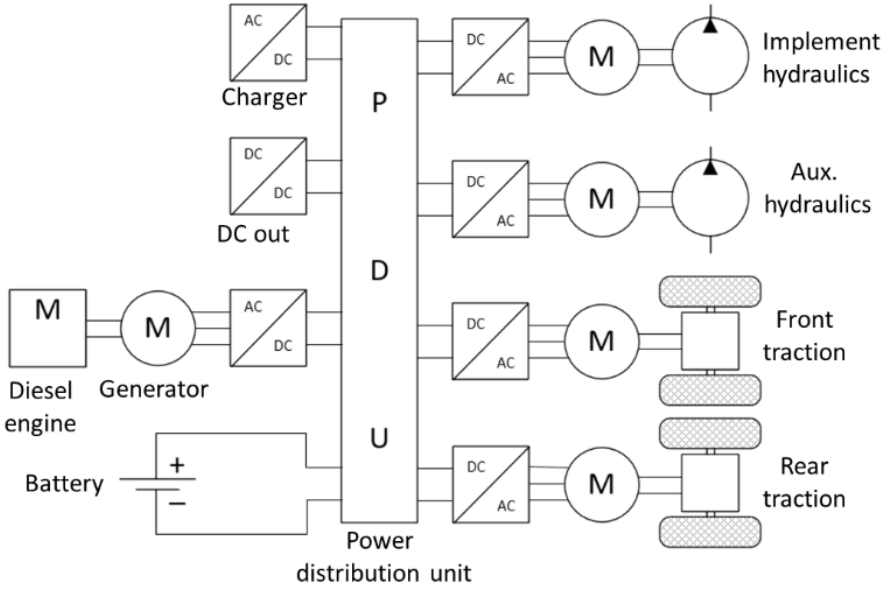
T. Tyni and J. Vepsäläinen, "Downsizing of Electric Motors by Utilizing Differential Gear for Traction and Hydraulic Pump of Heavy Mobile Machine," in *IEEE Access*, vol. 13, pp. 3284-3297, 2025, doi: 10.1109/ACCESS.2024.352150

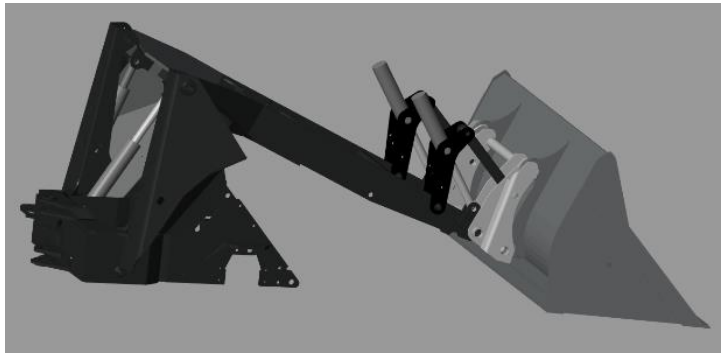
WP3: Experiments and Validation

Real-scale Mobile Machine test platforms

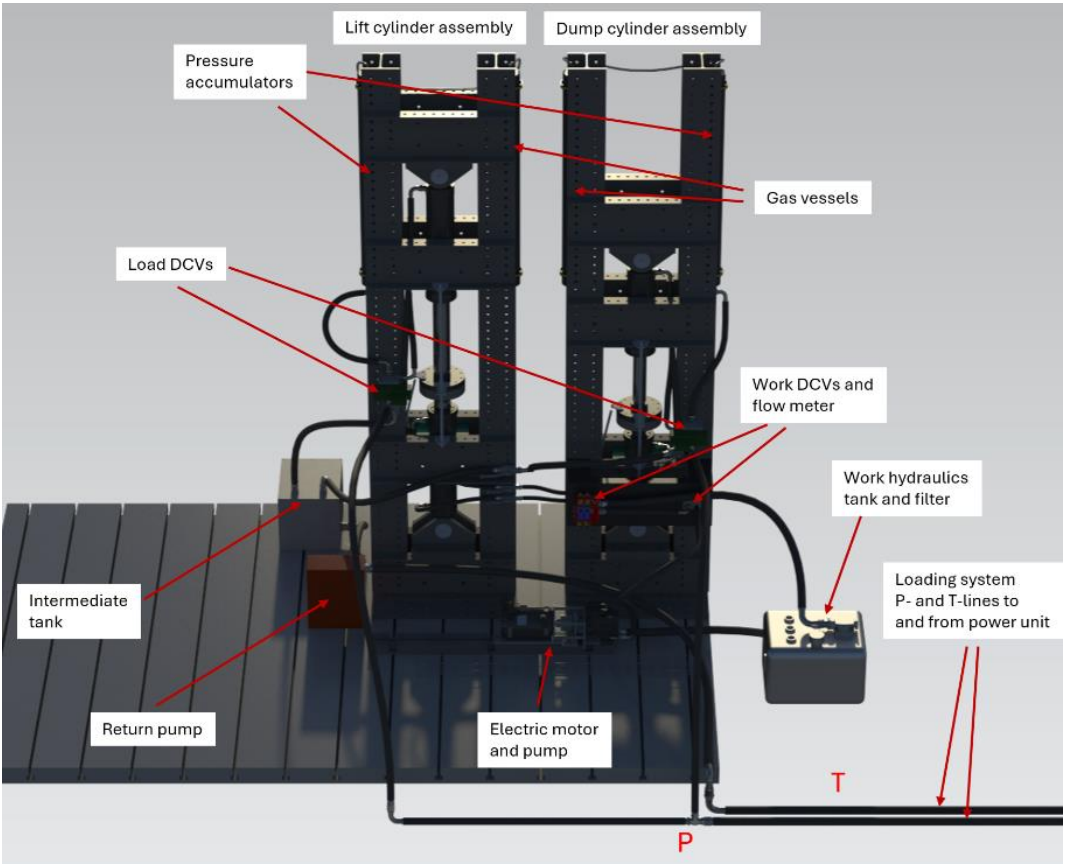
- Hybrid Wheel Loader (TAU)
  - Real-world operation and interactions
- Electric Mobile Machine Infrastructure (Aalto)
  - Hardware-in-the-loop system
  - Faster iteration of novel topologies

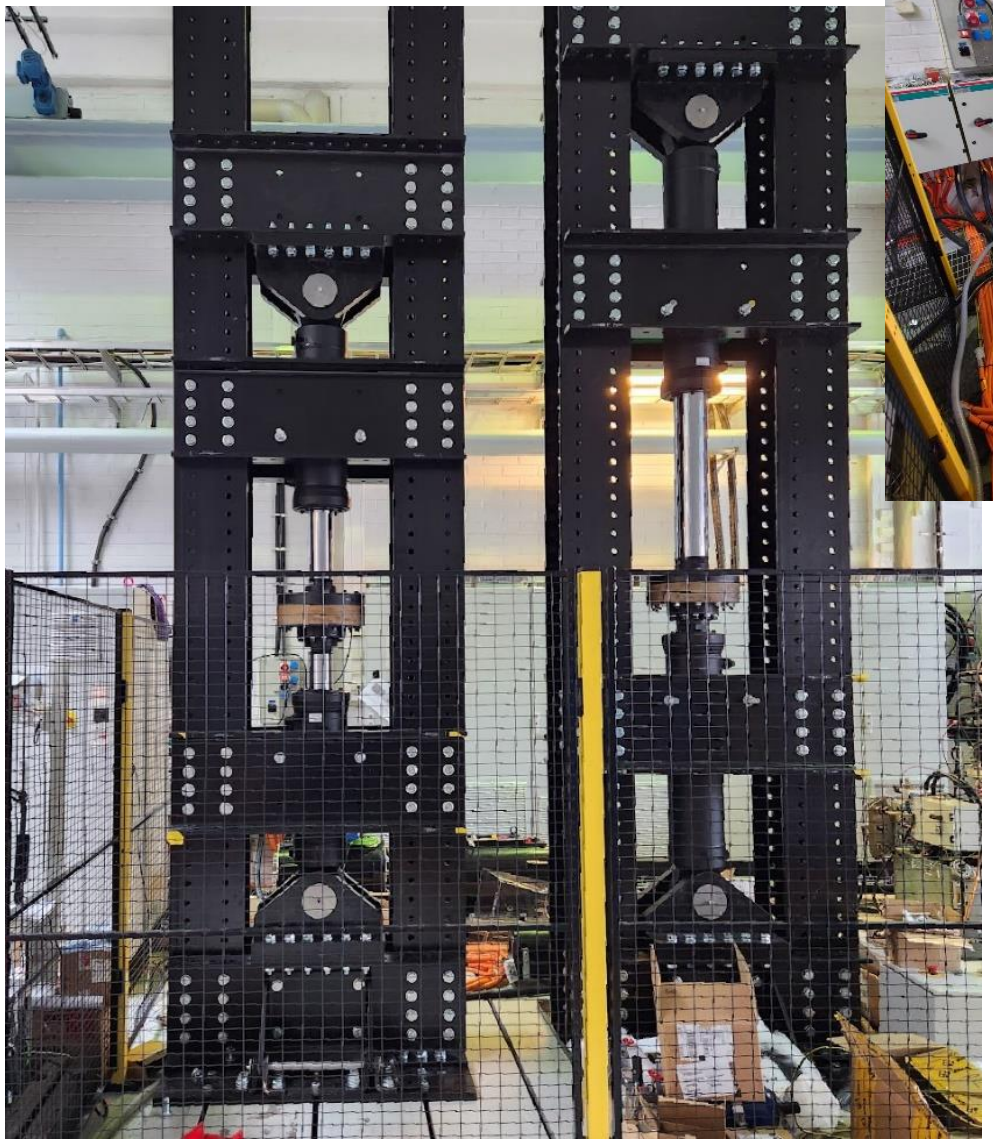
Series Hybrid Mobile Machine (sWille) @Tampere University





Large Electric Mobile Machine Infrastructure (LEMMI) @Aalto University





A!

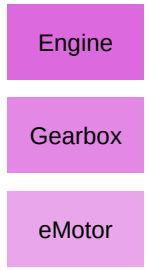
Jari Vepsäläinen 11.2.2025

WP4: AI supported system design

1. Task & Requirements

ChatGPT

LLMs



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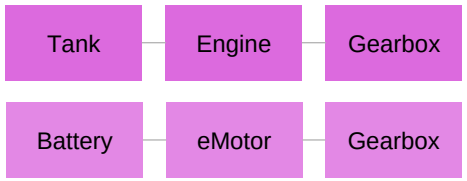
2. Component Library

Knowledge graphs



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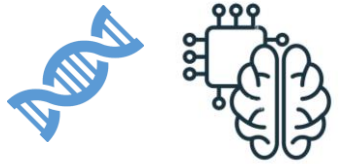
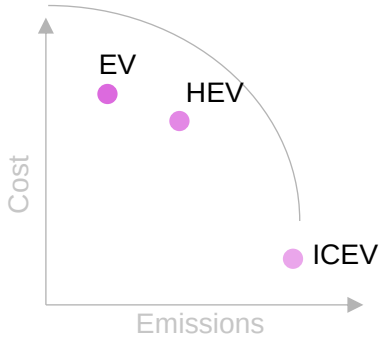
3. Iteration



GA, RL, …

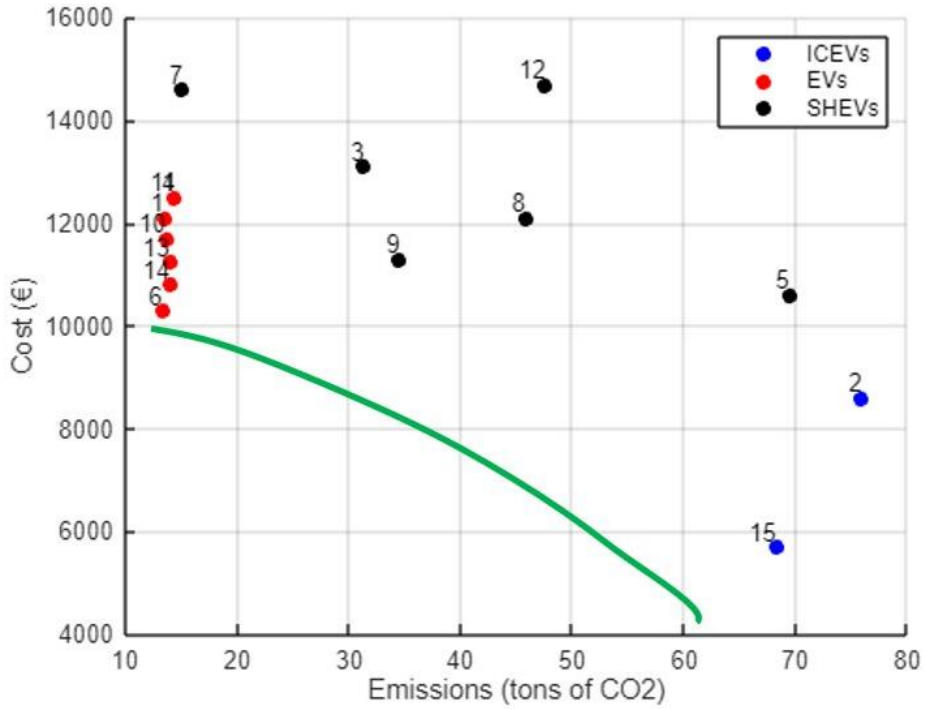


4. Results

Pareto optimality

A!

WP4 Preliminary Results



Proof-of-concept framework can autonomously generate, simulate and evaluate different powertrains.

R. Malik, M. Ahmad and J. Vepsäläinen, "Modular Representation of Components to Enable Generative Engineering," *2024 IEEE International Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles & International Transportation Electrification Conference (ESARS-ITEC)*, Naples, Italy, 2024, pp. 1-9

Summary – what is this project about?

1. Making mobile machines more energy efficient
2. Minimizing costs and size of components
3. Large-scale experiments
4. Improving the design process with AI

Preliminary findings based on computations

→ Experiments will be carried out to validate modelled concepts

ধন্যবাদ

Grazie

Tak

Cảm ơn

شكريه

谢谢

Merci

Спасибо

Ευχαριστώ

Gracias

Danke

Thank You

감사합니다

Dank

ขอบคุณ

धन्यवाद

Obrigado

ありがとう

Tack

Teşekkürler

شكرا

Kiitos

A!

Tampere University

MIXER

Consortium coordinator:
Prof. Roope Raisamo, Tampere University

(roope.raisamo@tuni.fi)

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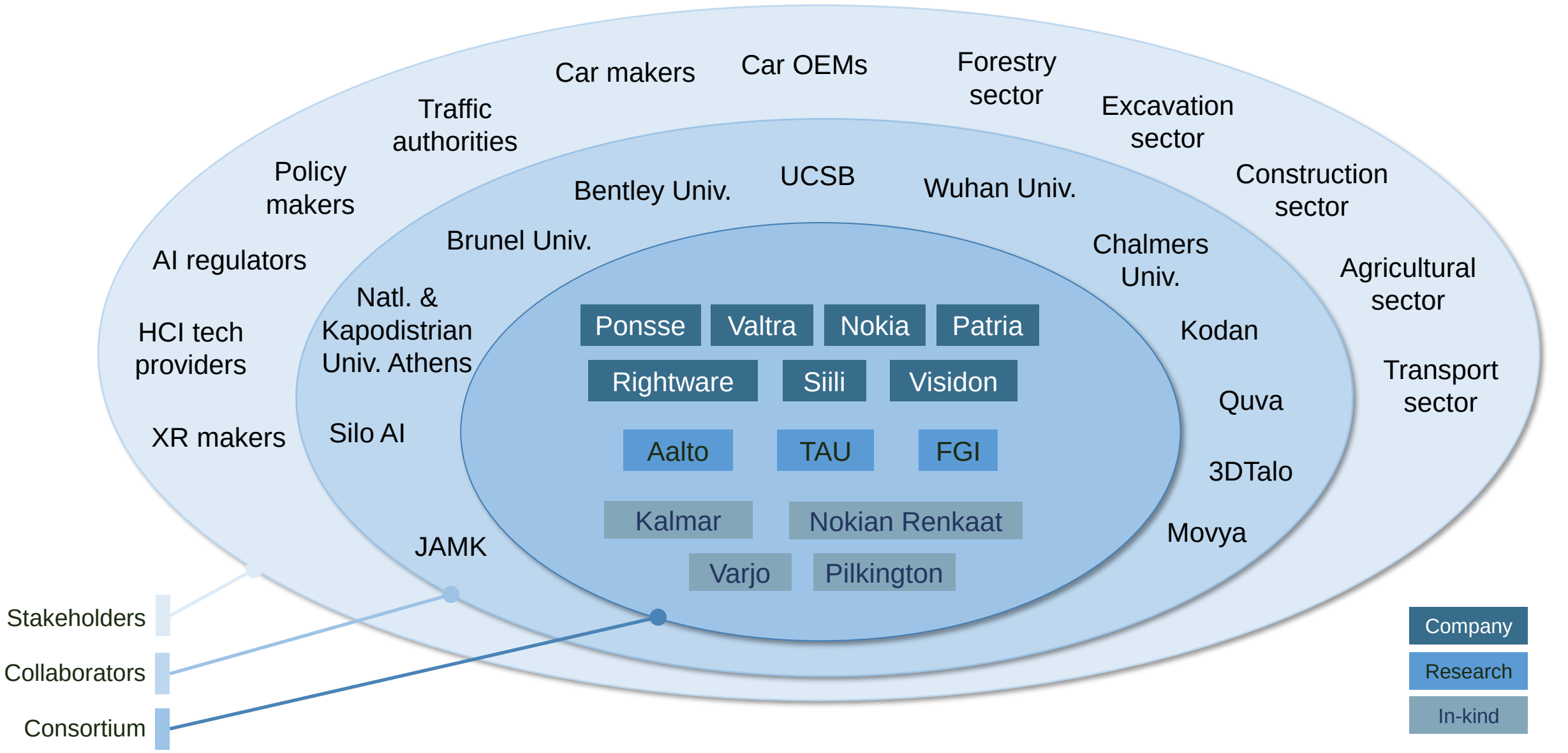
MIXER: Aware Multimodal Interaction and Extended Reality for Cars and Mobile Work Machines

- Co-innovation research project funded by Business Finland
- Project period: **1.4.2024 – 30.6.2026**
- A part of **Nokia Veturi 2 Competitive EDGE program and Ponsse/EPEC FORWARD-27 veturi program & Patria eAlliance**
- Budget: **9 M€**, BF-funding **4,7 M€**
- **Consortium: 7** company projects, **3** research projects, **4** in-kind companies

MIXER Ecosystem



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Key topics for MIXER

Information display

- Too much information!
- But HM users need it
- Must offer effortless, clear, concise presentation
- Prioritize critical info
- Study HUDs, AR
- Study alternative visuals

Situational awareness

- Situation perception, recognition, prediction
  - What the user is doing
  - What happens outside
  - What the user sees, knows
- Sensing inside and outside of the vehicle
  - Cameras, drones, road, ground, IoT sensors, weather data, vehicle parameters

Multimodal interaction

- Use different human senses adaptively
  - Visual, auditory, haptic, … interaction
- Selection by context
  - User preferences
  - Task at hand
  - Criticality of information
  - Cognitive load

AI tools

- Support and augment complex tasks with AI
  - Predict failures
  - Optimize machine settings
  - Improve efficiency
- Enhance operators' skills
  - Guide novice operators
  - Super powers to experts
  - On-the-spot training

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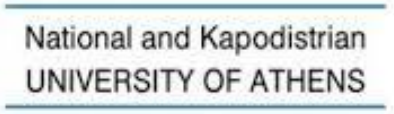
International collaboration

- University of California, Santa Barbara, CA, USA
- Eastern Washington University, Spokane, WA, USA
- **Bentley University, Waltham, MA, USA**
- **McGill University, Montreal, Canada**
- Chalmers University, Gothenburg, Sweden
- **Brunel University, London, UK**
- **Nokia Bell Labs, Cambridge, UK**
- National and Kapodistrian University of Athens, Greece
- Technische Universität Berlin, Germany



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Trends, driving factors

- Heavy machines and cars share many trends
- Passenger cars are changing rapidly
  - EVs, V2X, autonomy, remote, sharing economy
- New car technologies are useful to heavy machines
  - But heavy machine use is different, human-vehicle interaction is different:
- Research for new interaction solutions is needed!

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MIXER Objectives

- Improve safety
- Increase efficiency
- Enhance user experience
- Enable remote operation
- Improve training
- Promote sustainability

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Research: labs to the field

Photo © TAU


Photos © Ponsse

Comparison of TDA and AR UI on showing tree density

Ponsse simulator with green screen surrounding.
Varjo VR glasses
Simulated VR/AR environment
Simulated TDA UI on display

Study on different modalities supporting the driver's cognitive load. E.g. helping with audio, visual and possible haptic feedback in tree selection. The aim is to utilize existing tree database for modelling the environment.

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Tampereen yliopisto

Thank you for your attention!

Q & A

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KIITOS!

forward27.ponsse.com

Seuraava ekosysteemiwebinaari pe 21.2. klo 13-14

Esitysten aiheina fossiilivapaa teräs, tehdasympäristön tehostaminen ja työkoneiden automaatio

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