Human-Driven Industrial Metaverse

VTT initiative on Finnish industrial action

Focus on Common Cockpit vision for future of remote operation

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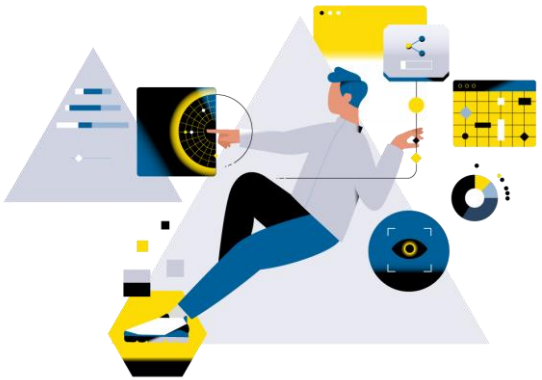
Agenda

1. Challenge, opportunity and vision
2. Future enabled by Human-Driven Industrial Metaverse in selected industrial domains
3. VTT innovation project and solution portfolio
4. Common Cockpit vision for future of remote operation

Challenge, opportunity and vision

Industrial metaverse – major opportunity for transformation of industrial work



WHY:

- Prevailing **labour crisis** in all industrial nations with aging population
- **Lack of appeal** in industrial work for present and future workforce
- Existing **small scale point solutions** for specific use cases in remote industrial work

WHAT:

- Enable meaningful, inspiring industrial careers for future workforce based on hybrid and remote work – **uniting blue collar and white collar**, not only for the PC/meeting crowd
- Establish new sustainable, flexible and productive ways of working in **distributed organizations as "gig workers"** (https://en.wikipedia.org/wiki/Gig_worker)

HOW:

- Develop desirable, viable, acceptable and technologically feasible **cross industry solutions** enabling radical business renewal
- Boost scalability from **convergence** of private and professional solutions, similar to mobile phone revolution

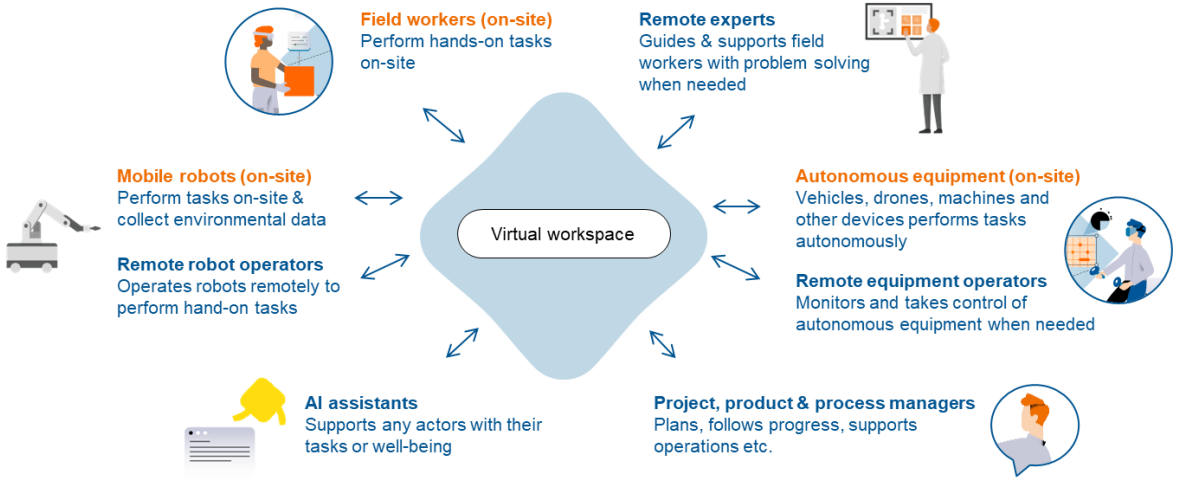
Human-Driven Industrial metaverse vision and definition

Industrial Metaverse is a virtual workspace connecting and providing access to geographically separated experts, objects, information and work environments.

People can work in a purely virtual environment or in a hybrid environment that combines both virtual and physical environments in order to support individual or collaborative work.

Shared Reality (SR) will be the next step going beyond eXtended Reality (XR)

Dynamic, emotion recognition based user interface technologies will emerge for workload adaptation and well-being.



Vision for Finland, 203X

Enable attractive and productive careers in location independent industrial work in all human-centric verticals from manufacturing, maintenance, construction to logistics and mobility systems

Make Finland a global leader, leading Europe as the best place for R&D in solutions and to work in the Industrial Metaverse, merger of physical and virtual worlds

Future enabled by Human-Driven Industrial Metaverse in selected industrial domains

Important considerations when working in industrial metaverse

Working in virtual environment
Physical and cognitive ergonomics (e.g., simulator sickness, comfort, mental load)
Tools and means of manipulation

Hybrid work
Smooth transfer between virtual and physical tasks

Complex systems
Managing human-technology-AI teams working together in hybrid environments

Safety and ethics
Safe workways and privacy ensured
Inclusiveness

Motivation and feeling of meaningfulness
Working based on employees' values
Work-life balance

Social aspects at work
Being part of the work community

Novel ways of working
New work ways emerge, old ones disappear
Improve performance

Mobile robotics

Emotionally adaptive technologies - artificial emotional intelligence

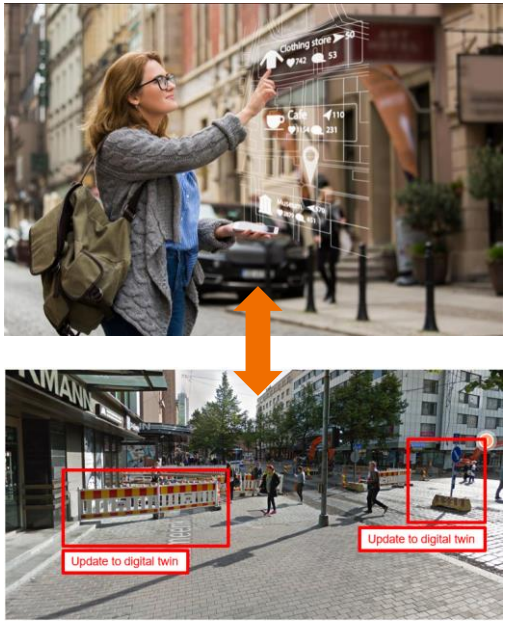
Example

VISION: Real time digital twins in the built environment metaverse

WHAT IF…

All people become sensors - **citizens** moving around and **professionals** working in the built environment - in addition to experiencing augmented data on the surroundings, are willing **to share the data captured** with their multi sensored **Shared Reality (SR)** headsets

This **crowdsourced data** is used, along with data captured by fixed/mobile mounted sensors to **update the digital twin of the environment in real time** to make it a **powerful tool for work**. AI will detect anomalies and make real life twin available for professionals for situational awareness, operation and maintenance



Experiencing and interacting with the digital twin with a headset replacing the phone screen

Sharing the reality to update the digital twin, getting paid for it

Value generation: A metaverse service provider maintains the digital twin, offers its content to various stakeholders, collects data from people, offers headsets and service free of charge to consumers as an incentive to enable crowdsourcing

Example

VISION: Employing local labour to reduce expert travel in industrial work

WHAT IF…

Building infra from elevators and HVAC all the way to access control, copy machines and coffee makers can be fixed by **local janitors**;

Factory or construction site audits can be performed locally with basic skills **monitored by the responsible auditor off site**;

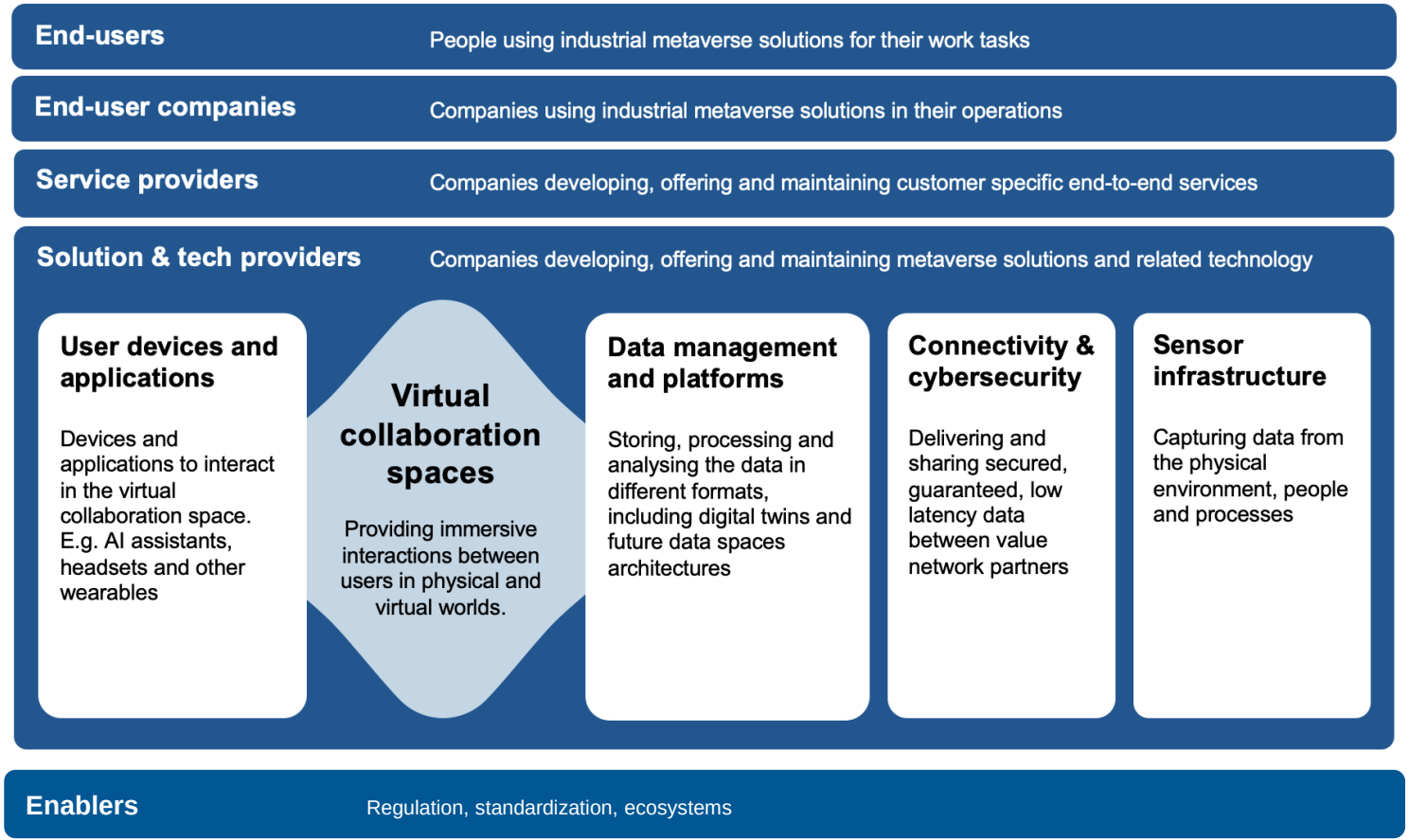
Basic maintenance & checks of **remote built infrastructure** (transport, telecom, energy) by local inhabitants, farmers or fishermen;

…using **SR headsets** & immersive workspaces, supported by location independent experts and generative AI based remote assistants.

… with spare parts and tools delivered by **multimodal autonomous supply chains**.

Business potential: Local employment, attractive secondary jobs, rapid response and short downtime, reduced travel/commuting related time and OPEX

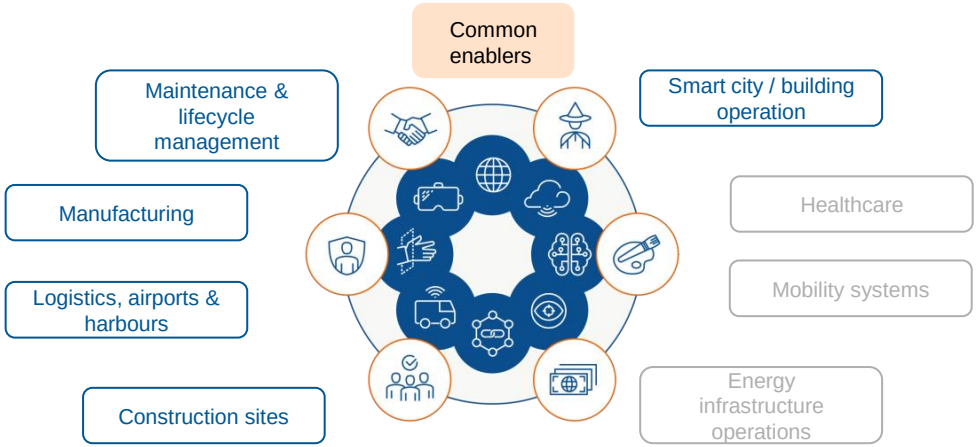
Industrial Metaverse stakeholder map



VTT innovation project and solution portfolio

https://www.vttresearch.com/en/ourservices/human-driven-industrial-metaverse-solutions

Humiverse project 2022-2023 for cross industry opportunity identification



Project partners

Possible future partners

Telia Company

SULAVA

VALMET AUTOMOTIVE

FINAVIA

dazzle

Nordkapp

KONE

Granlund

YIT

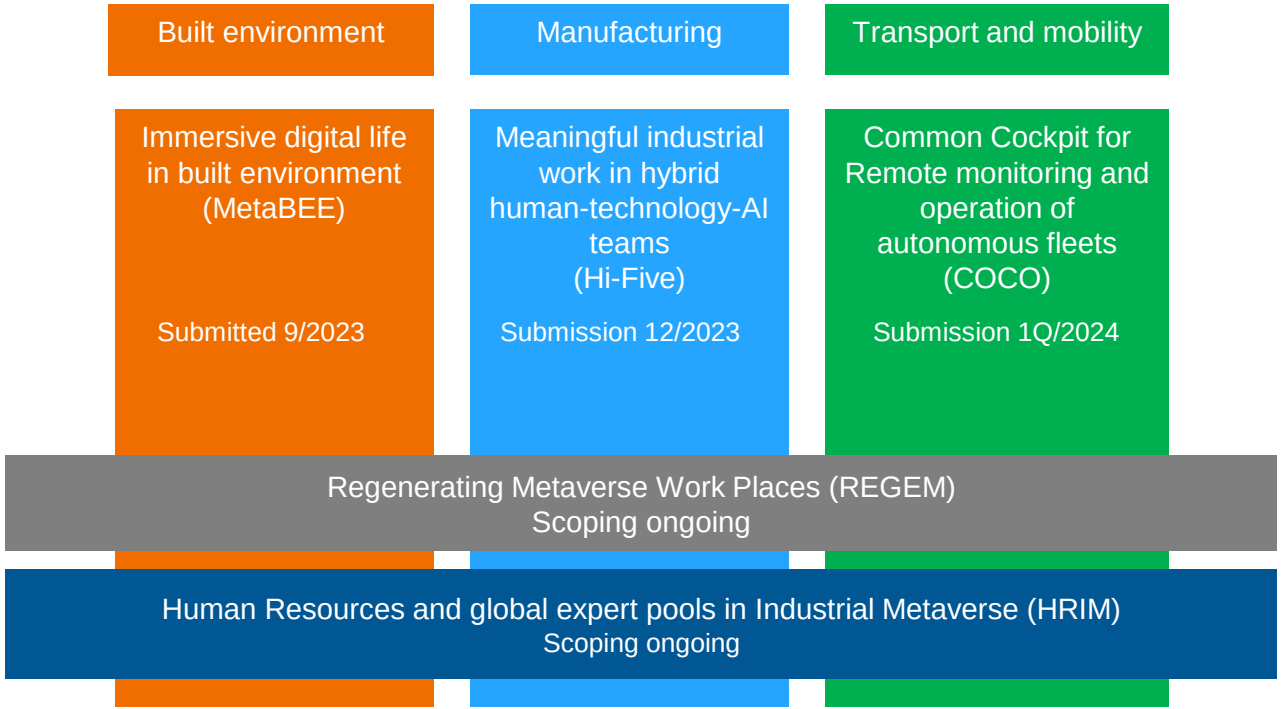
ZOAN

Augment

VTT

We are now preparing several high impact industrial partnership projects

(Business Finland co-innovation funding)



Common Cockpit vision for future of remote operation

Common Cockpit vision for remote monitoring and operation of autonomous fleets

WHAT IF…

All autonomous equipment, from mobile work machines in isolated forests & mines to trucks and cranes in fenced harbours & airports to maintenance vehicles and public transport in populated areas, mobile robotics and even future unmanned drones and aviation would be remotely monitored and operated by an **emerging new profession "remote operator".**

These remote operators, certified for various remote operation tasks, not only driving but also supporting roles, based on their interest, seniority and experience, would form a **global pool of experts**, employed by staffing companies or as freelancers, available for **pre-planned or ad-hoc demand based operator intervention.**

Connecting the operator to the vehicle would happen instantly through **interconnection of metaverse platforms of the vehicle owner/customer and the staffing company**, covering also advance resource planning, operator authentification, cybersecurity and commercial transactions. Everything based on "gig economy" driven by workforce of the future.

The operator would work in a regulated **Common Cockpit – workspace based on dominant design** that fits anywhere, from hybrid offices to living room corner or summer cottage - with novel Shared Reality and haptics based control, providing an enriched ergonomic experience (from interactive AI assistants and 3D see-through to cognitive monitoring & adaptation).

Value generation: Resource efficiency for equipment operators, attractive jobs and wellbeing for humans, transaction business for staffing platform developers and agencies, scalable solutions via dominant design to workspace & user interface companies, connectivity service revenue for telcos.

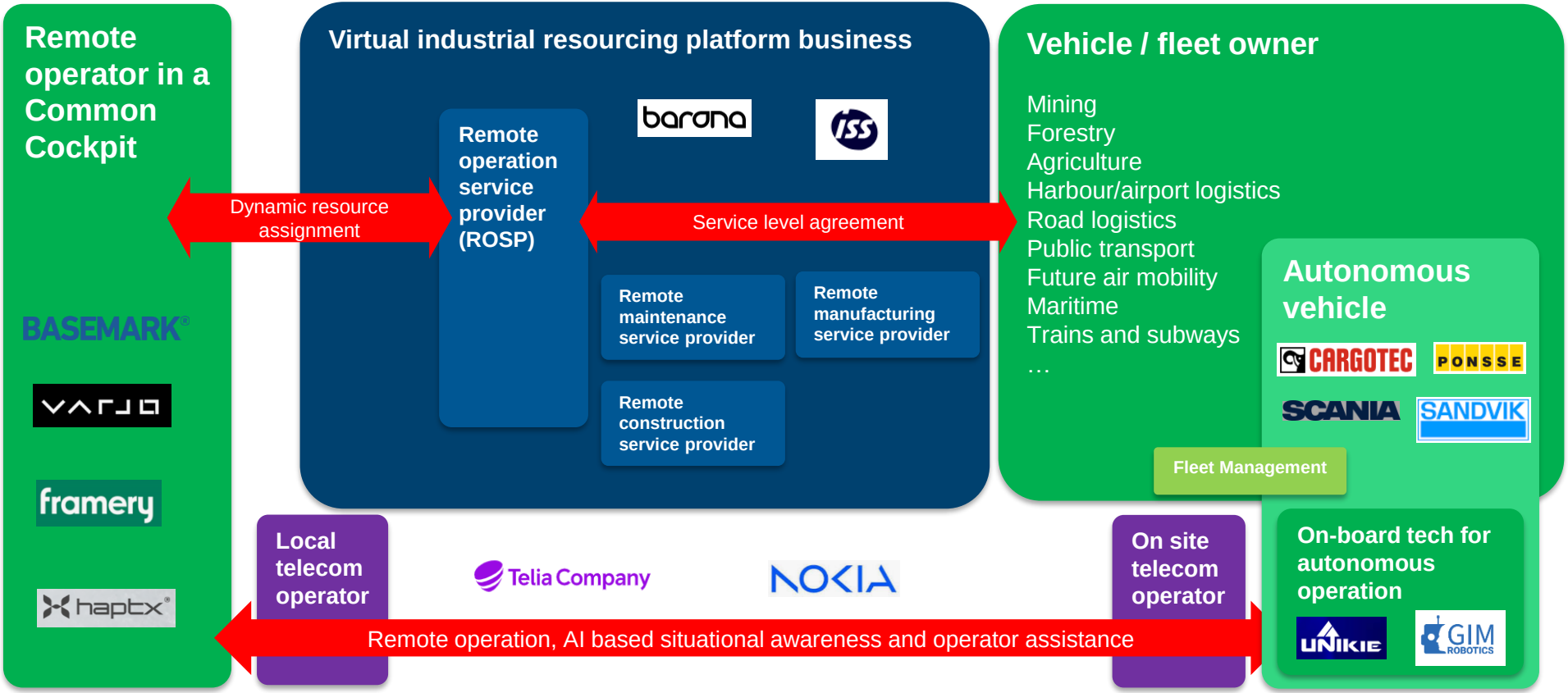
Monitoring and operation of all autonomous mobile equipment…

… flexibly and securely from anywhere…

…with haptics and SR enabling a virtual cockpit for multiple use cases.

Future remote operation of autonomous fleets

(example companies illustrative only)



Potential roadmap towards Common Cockpit vision – will be developed in the co-innovation project

Remote operation from fleet owner premises

Already ongoing in mining and ports. Challenges in highly regulated, safety critical and public environments. Research focus in vehicle systems on site

Remote operation as a service

Work from office environment. Research focus in operational benefits, secured remote operation, inter-organizational virtual co-operation and safety culture.

Location independent remote operation

Work from home. Research focus in Common Cockpit technology and secured end-to-end wide area connectivity.

Global pool of operators and “gig work”

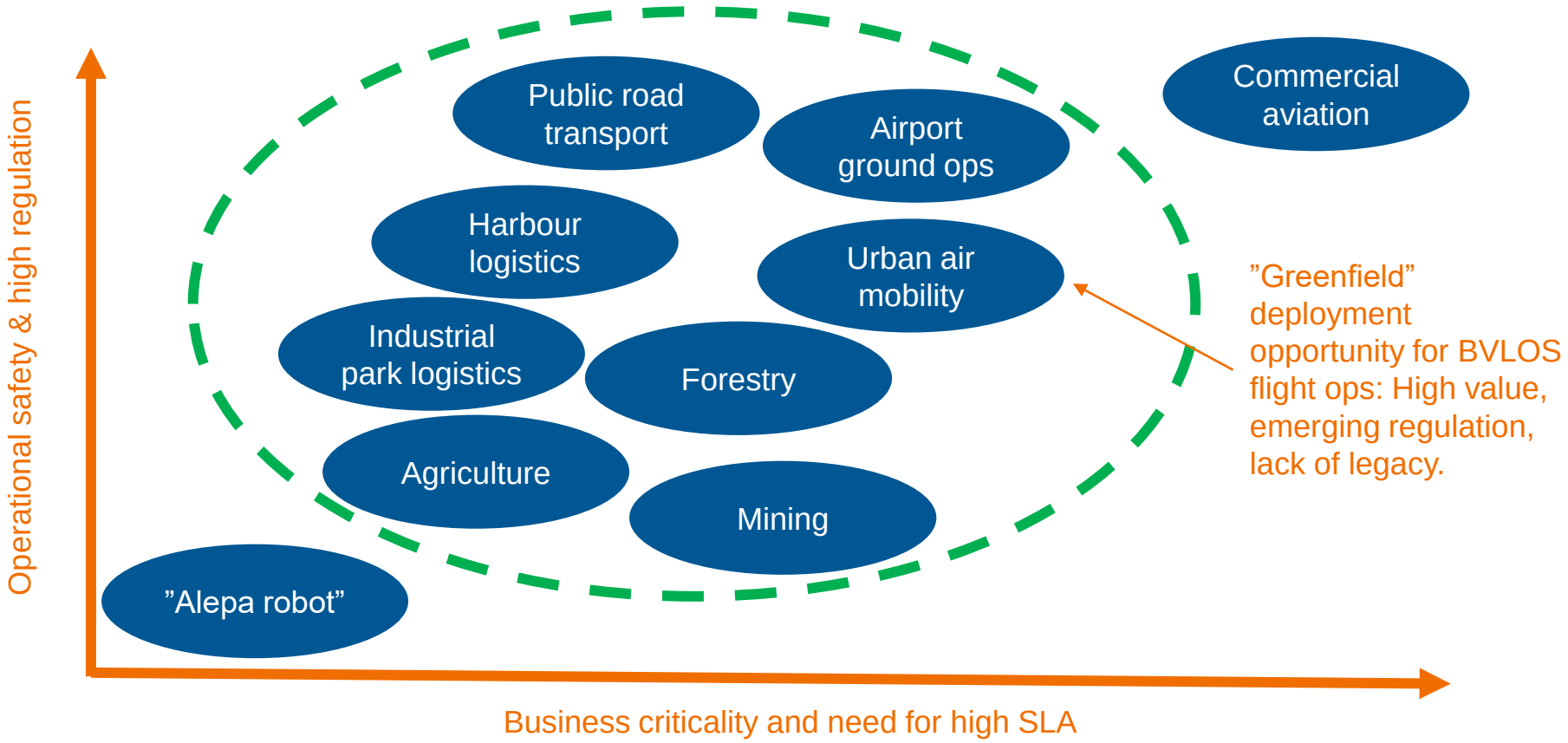
Remote operators dynamically assigned from a global pool of resources, managed by Remote Operation Service Provider. Research focus in data management and scalable business operations.

Increasing fleet sizes under remote operation

Increasing pressure in availability and productivity of operators

Technical maturity, economic feasibility and regulatory acceptance improving

Operational environments for remote operation – sweet spot for business impact?



New business opportunity: Remote Operation Service Provider (ROSP)

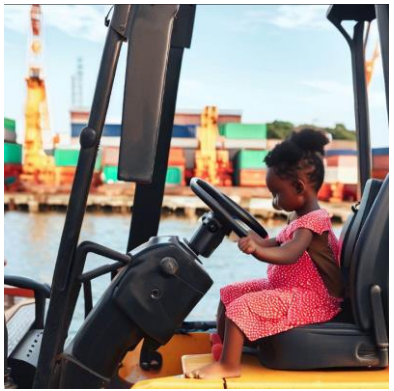
- Highly scalable capability to provide remote operation services globally to different segments of autonomous vehicle fleet owners
- Revenue from Service Level Agreements with fleet owners
- Not only driving but variety of activities from disptach, fleet monitoring, exception management, external collaboration and fleet intelligence to remote diagnostics and operator intervention (planned and ad-hoc)
- Resourcing of remote operator individuals to form a pool meeting customer demand
  - Training and certification
  - Management of well-being and job satisfaction
  - Provisioning of Common Cockpit equipment for office or home based work
- Aligned with Human Driven Industrial Metaverse vision for Finland as home base for remote operators (”operate a harbour crane in San Francisco from the comfort of your lakeside cottage in Finland”)

VTT research questions addressing business challenges and opportunities

- Advanced sensors and situational awareness, autonomous operations in land, sea and air.
- AI assisted remote operations, situation rewind & fast forward for recommended human actions
- 5G+ command & control connectivity, cybersecurity
- Safety management, safety culture development, operational insurance
- AI assisted dynamic resource assignment and fleet management
- Concept of operations in different segments
- Operator performance & cognitive load management
- Demanding pilots and techno-economic proof-of-concepts both in real-life environments and in managed laboratory conditions
- …

Would Common Cockpit enable industrial dream jobs?

- Today’s 12-year-olds live in the virtual world, it is a natural environment for them
- When they reach working age, the ”normal” for them is likely to be virtual rather than physical environments
- It makes sense to play to their strengths in planning their professional tools & world
- Future of industrial work as ”gig work”?



In 2023?

In 2035?

VTT

beyond

the obvious