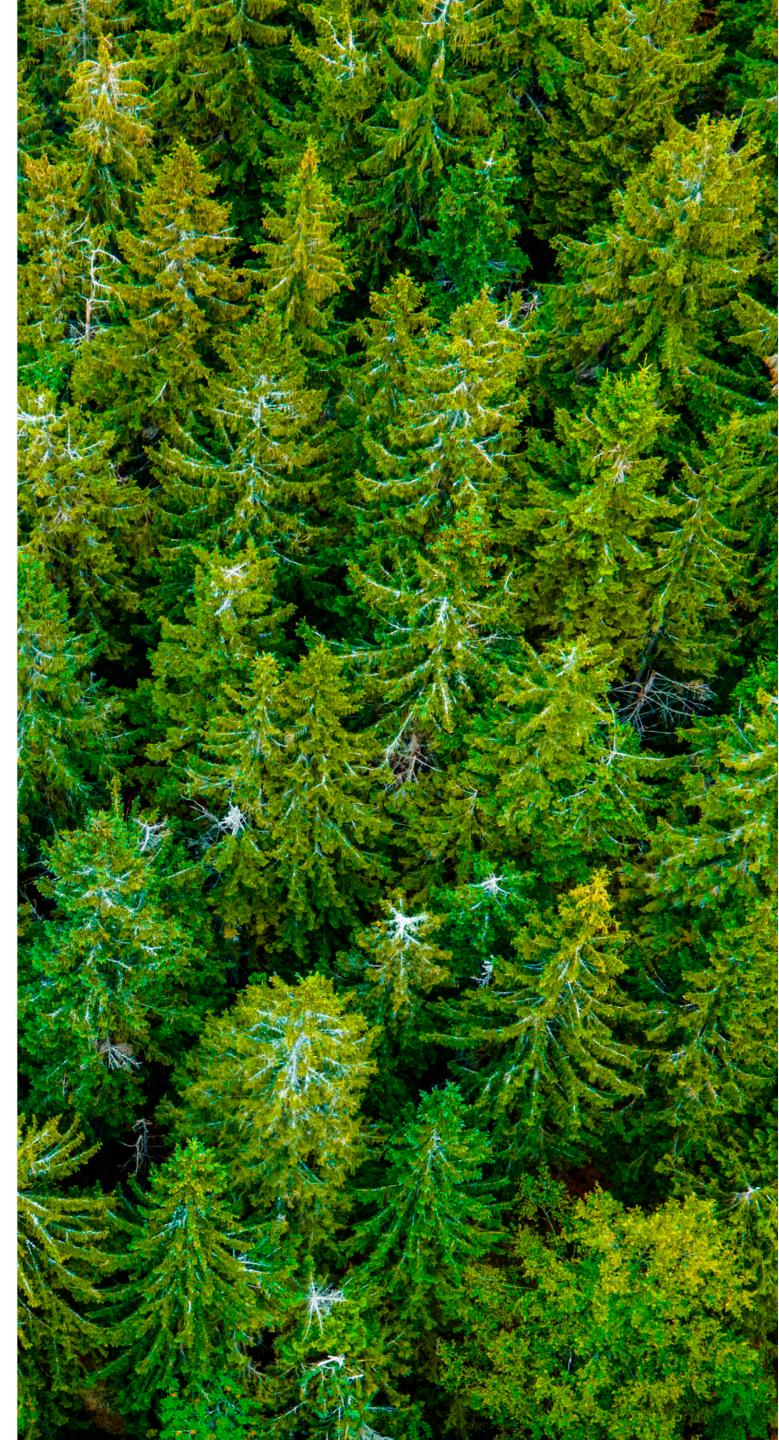




SIE Sustainable Industry Ecosystem

Prof. Dr. Minna Lanz
minna.lanz@tuni.fi

Tampere University



Test before invest with pilot lines - How to collaborate between industry and academia

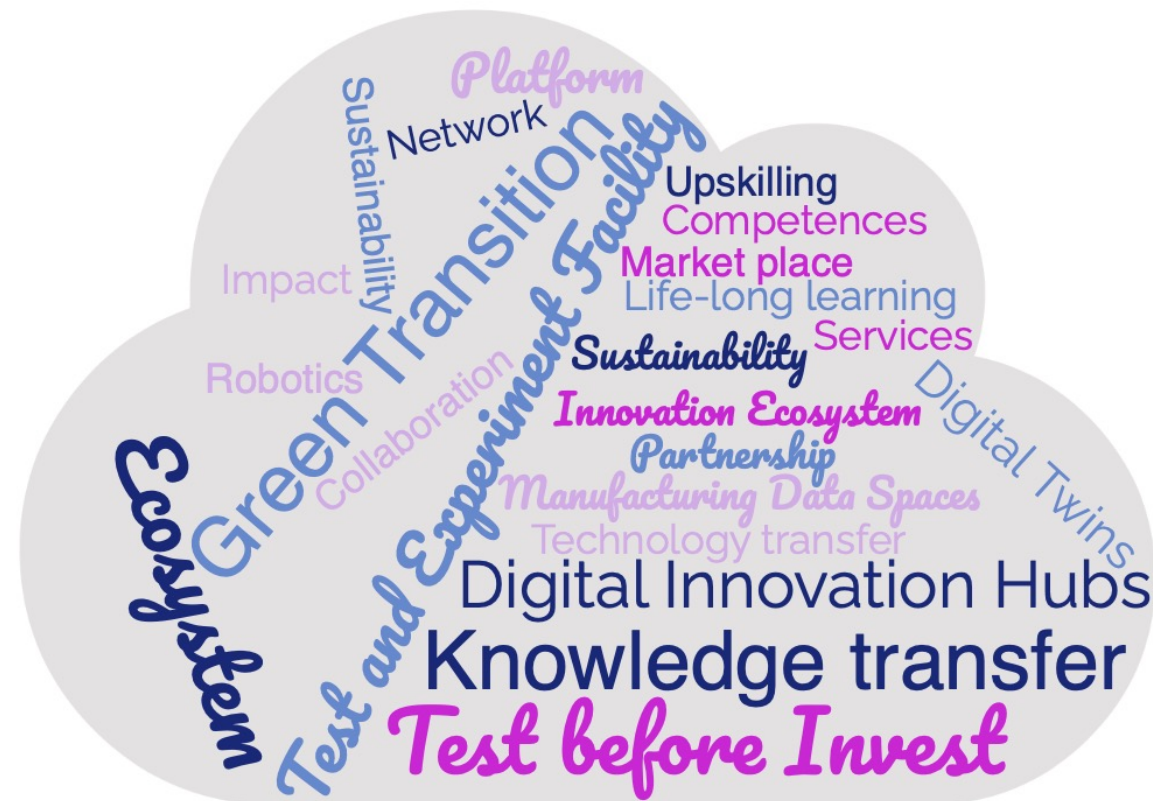
Challenges from the field

Test and experiment facilities (TEFs) and Pilot Lines

Educational collaboration

Joint Research projects

Industry examples



*H2020, Horizon Europe

Mobile Robotics Industry in

2021

Mobile Robotics Growth and Changes

The COVID-19 pandemic has resulted in the demand for the deployment of robots for tasks like automatic disinfection. The mobile robotics industry is expected to reach

\$23 billion in 2021
as a result of these new use cases.

AMRs

will be more widely accepted for conducting labor-intensive tasks, allowing workers to focus more on decision-making and less on labor.

The market for industrial robots has been growing at an

annual rate of 19%

since 2012 and is expected to continue double-digit growth through 2021.



Revenue in the mobile robotics industry will reach
\$2.4 Billion
by the end of 2020 and will increase by 50% in 2021.



Revenue for the AMR and AGV sectors is on track to grow by **24%** in 2021 despite COVID-19.



Research shows that AMRs will see revenue growth of **45%**

Technology Trends and Expectations



2021
will see a rise in the demand for Collaborative Robots (Cobots)

Cobot growth is expected to continue and by 2025, will make up

34% of robot sales

Advances in vision-based navigation and sensor fusion mean AMRs are expected to outnumber AGVs by

2030

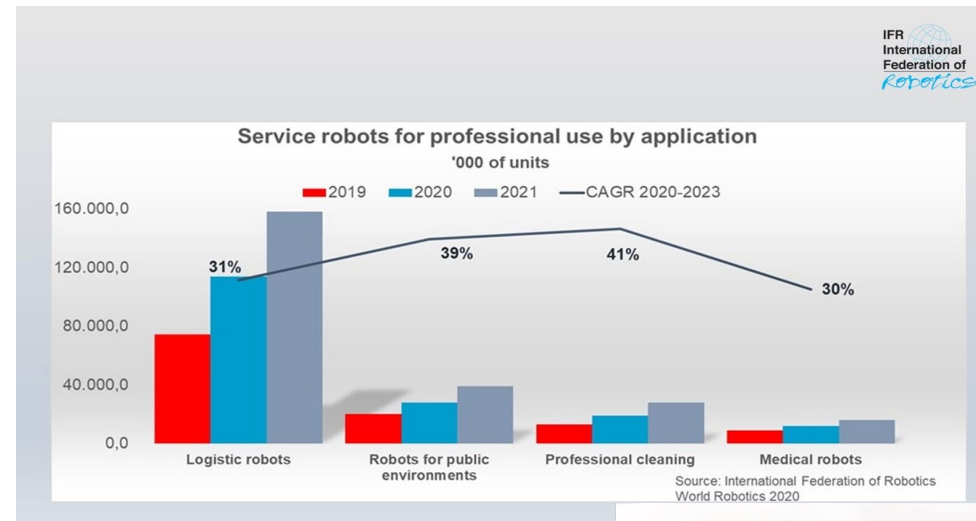
The robot sensor market will experience a CAGR (compound annual growth rate) of **10%** through 2026

Sectors to Watch



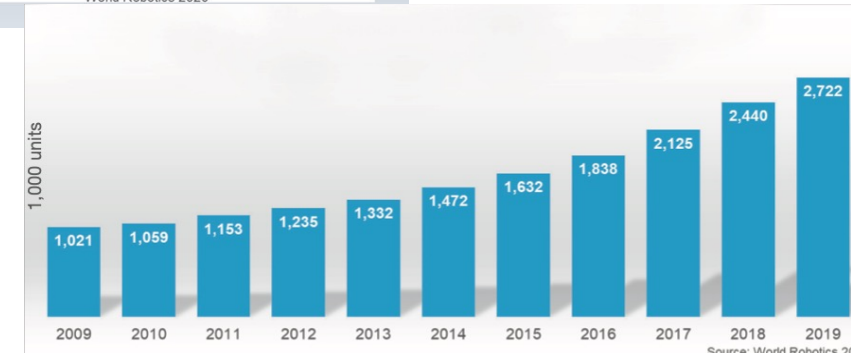
Key technology trends covered:

- Ecommerce retailers will embrace customer immersion technologies.
- Encryption/data privacy services will become mandatory—and profitable.
- Automation & robotics will infiltrate all stages of the supply chain.
- We've only just scratched the surface of virtual care.
- From Cobots & Beyond: Factory automation will boom.



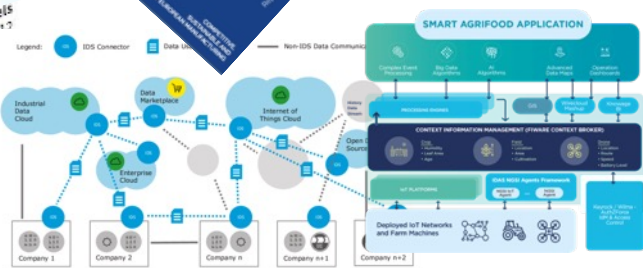
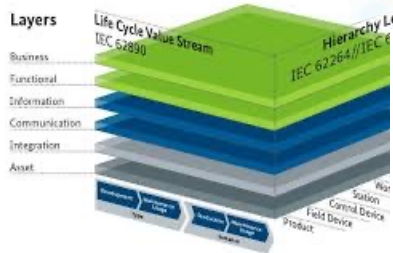
IFR: Operational stock of industrial robots – world

IFR releases paper “A Mobile Revolution”



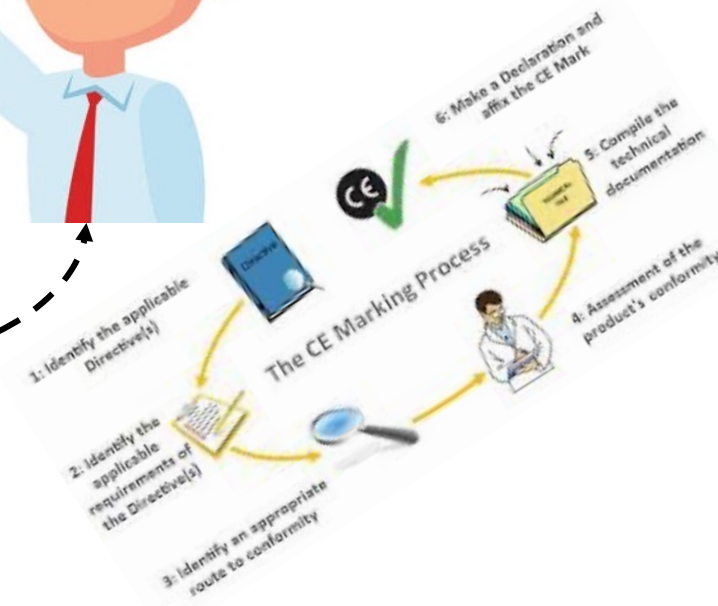
Couple of barriers for uptake

Excellent Visions

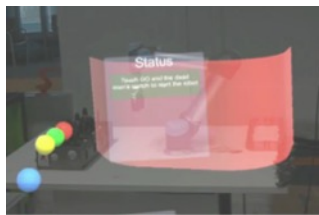
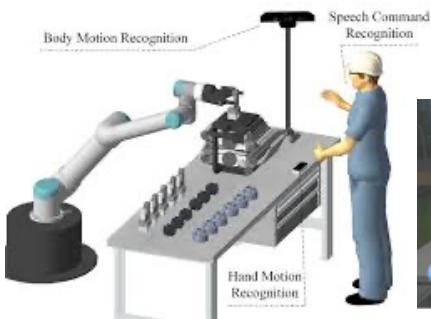


New platforms

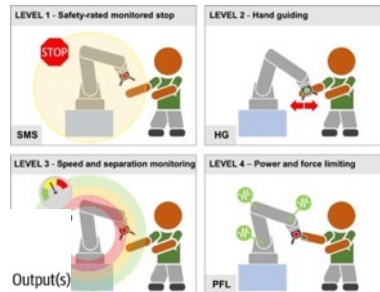
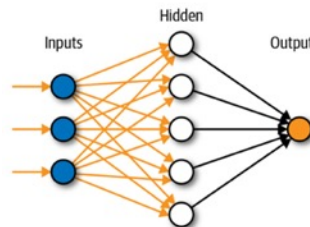
Wonder if it works?
Do we have enough engineers?



Emerging fancy tech

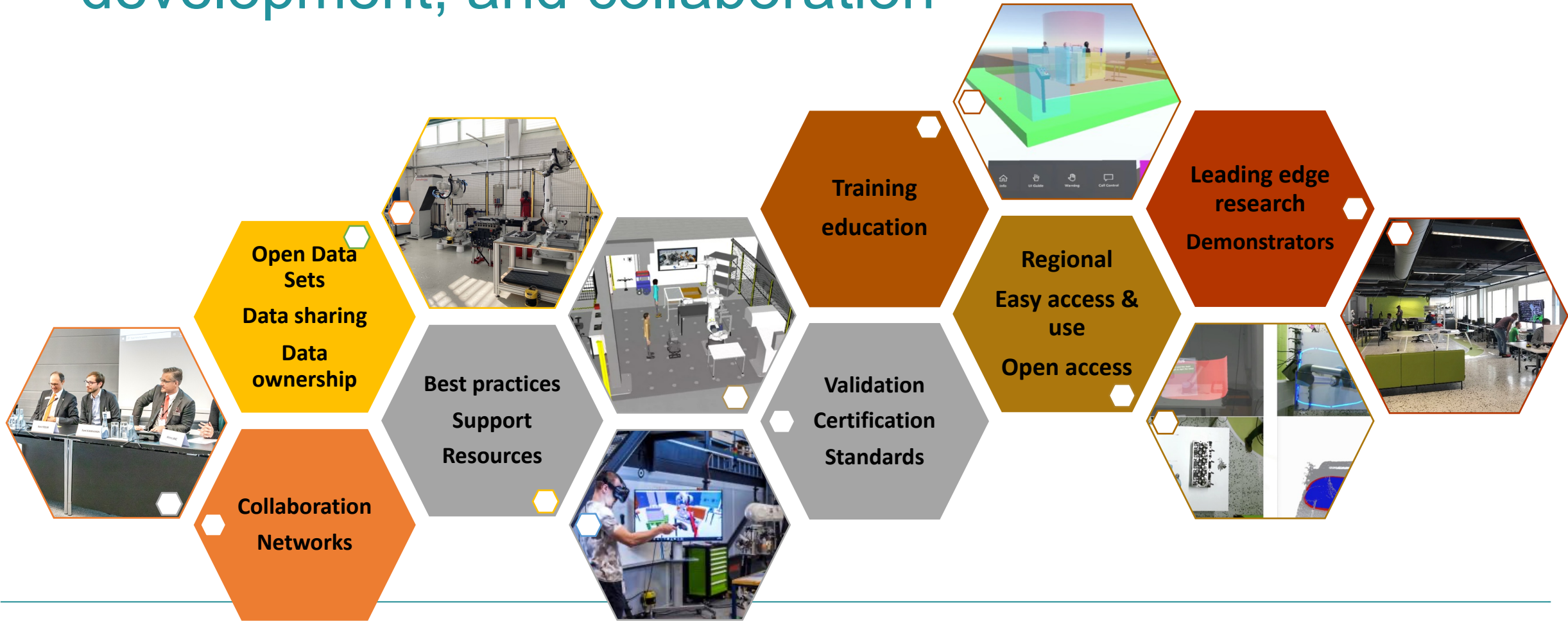


Artificial Neural Network



How to speed up skills development and technology up-take

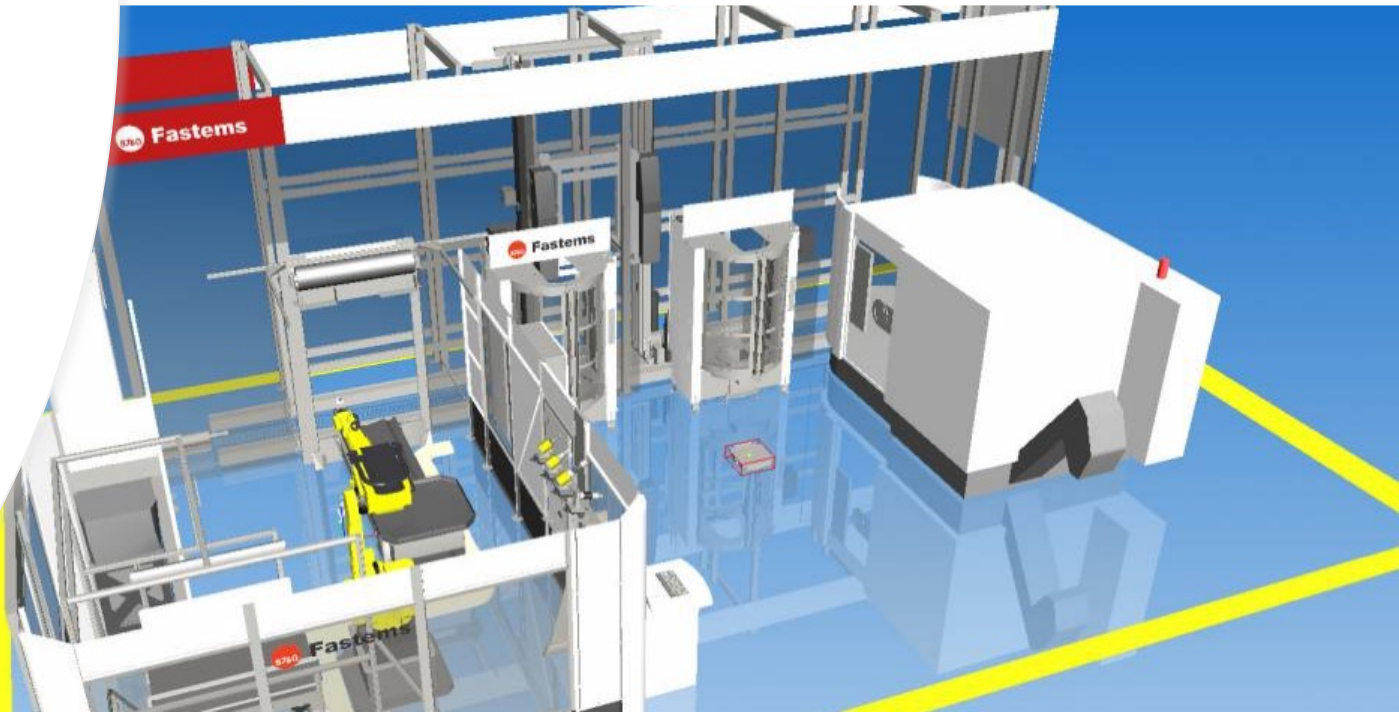
Test and Experiment, network and Skills development, and collaboration



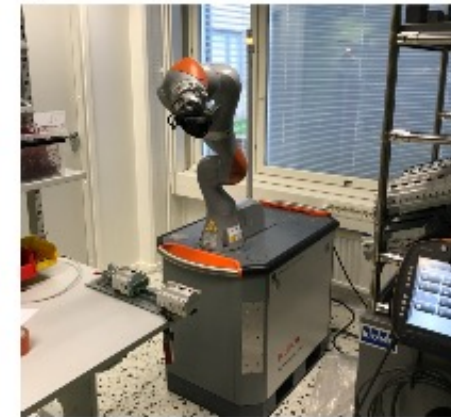
FMS Training Centre

- Joint educational factory FMS Training Center located in the Fastems Factory floor.
- Up and running since 1999
- Co-owned by Fastems Oy, Tampere University, Tampere University of Applied Science and Tampere Vocational school
- BSc and MSc level exercises for students and for Fastems customers
- Testing of both HW and SW solutions

<https://research.tuni.fi/virtualfms/>



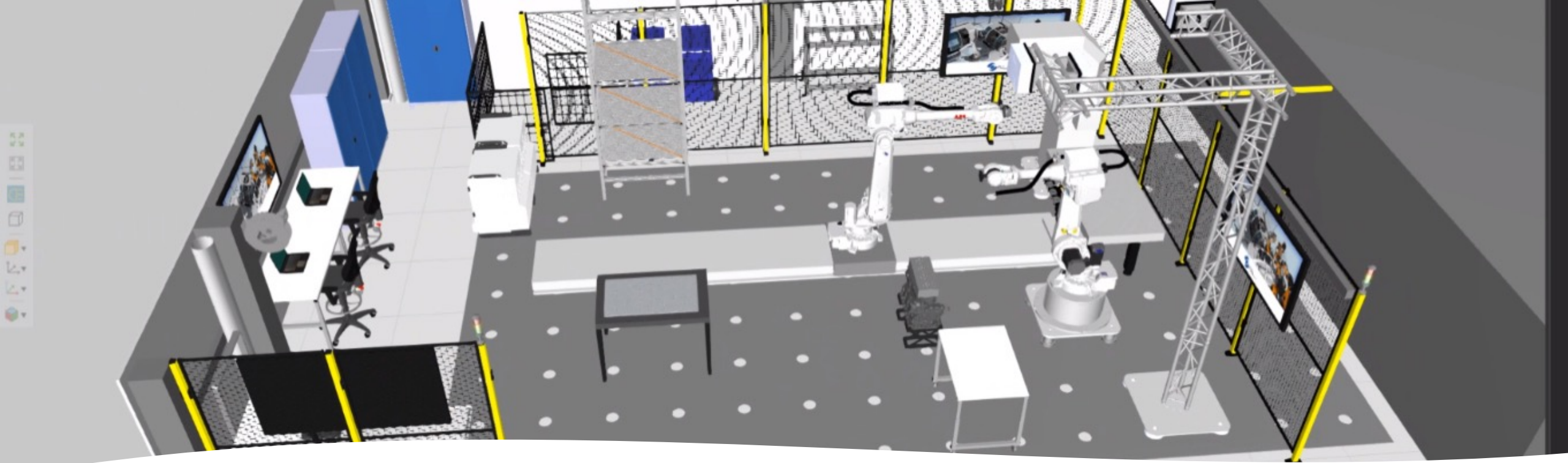
RoboLab Tampere – for small scale test and experiments for academy-industry collaboration



b)

<https://research.tuni.fi/roboabtampere/>

e)



Mid-Heavy robotics testing environment @TAU HRC Pilot Line

- Human-Robot Collaboration Pilot Line for academy-industry collaboration
- Fully reconfigurable robotics lab for Mid&Heavy-duty assembly applications
- Full AR/VR capabilities
- Safety:
 - ABB Safe Move, Laser Scanners, Light curtains
 - House-build 3D depth sensor based safety, monitoring and interaction system

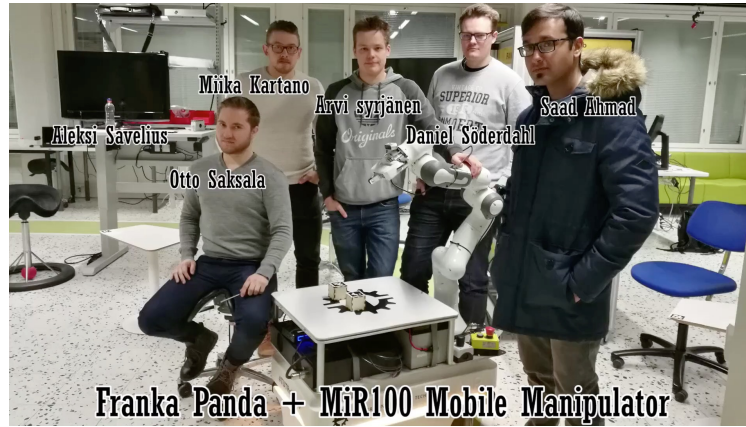
<https://research.tuni.fi/hrc-pilotline/>



University-Industry joint skills development

| Type of activity | Example | Target group |
|---|---|---|
| BSc theses | BSc theses with industrial robotics and signal processing | BSc. Level students |
| MSc level laboratory courses for Robotics Major, and minor in Industrial Robotics | MSc level education: Phenomena based and highly problem-solving oriented laboratory courses with industrial case problems and modern industry robots | MSc. Level students |
| MSc theses | Hand movement tracking with depth sensors and motion duplication with robot arm, Learning motion generating dynamical systems from human demonstration, Evaluation of Human-Robot Collaboration (HRC) in light-weight assembly task | MSc. Level students |
| D.Sc. thesis/academic research | Vision-Based Mobile Manipulation, Vision based safety system in HRC | PhD/D.Sc. level students, Industrial partners |
| Pre-competitive research | Feasibility testing of HRC capabilities, feasibility test on manipulation of small and flexible parts, Technology transfer | Industrial partners |

<https://www.youtube.com/channel/UCokZXa5w80D51MGTD>
COiUWw

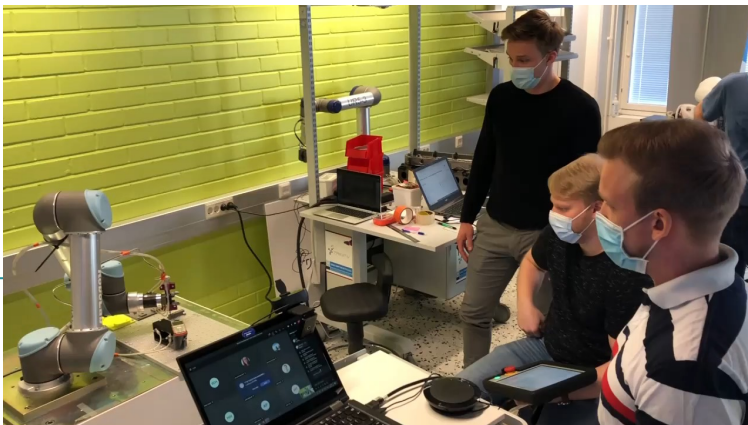


 Tampere University

Voice jogging of robot arm

Kone533 Robotics Project Work

Ara Jo
Mikko Kulju
Niklas Sorri
Omar Hassan



MSc students' project works

H2020 TRINITY 2019-2023

Network of DIHs

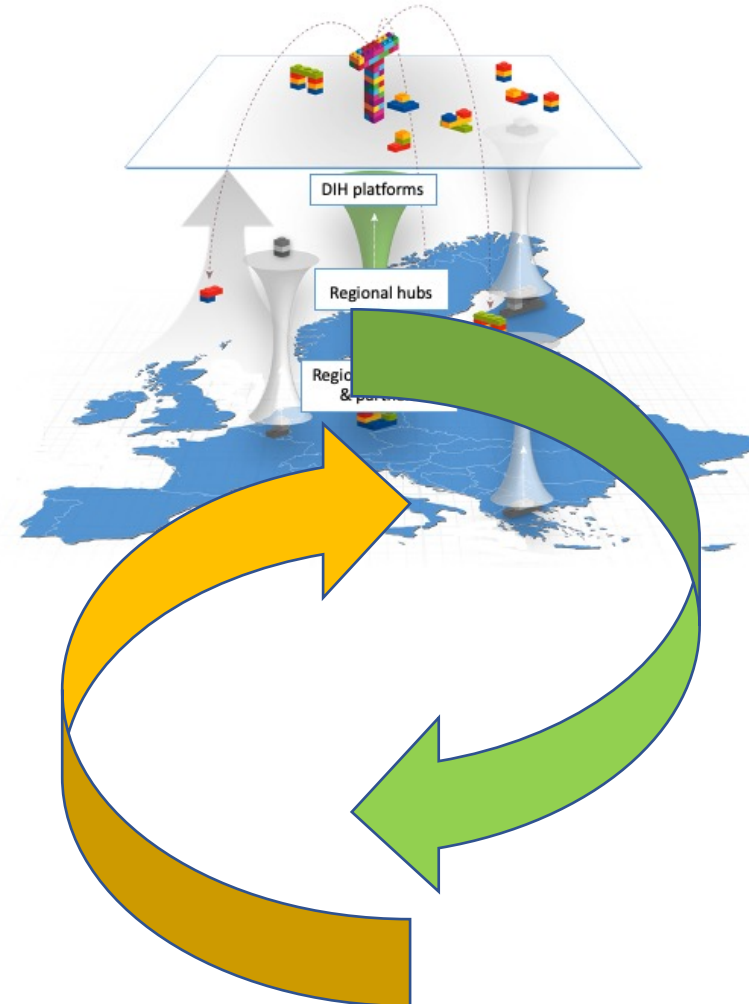
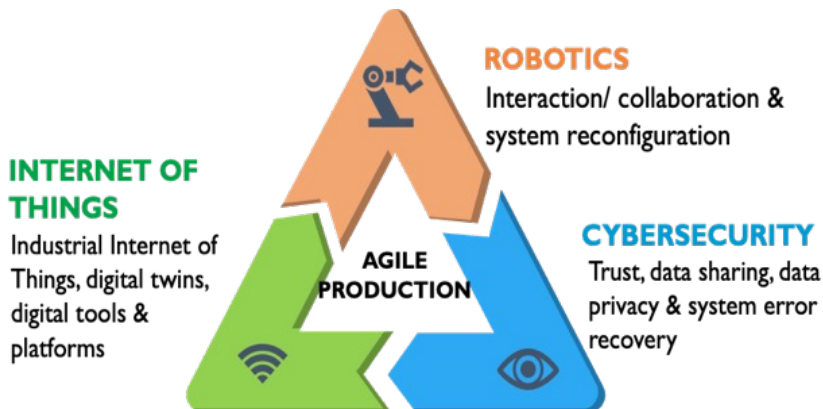
Demo Program 1 (2021)

- 19 consortiums, 44 partners, 14 European countries
- Total budget 4.66 M€

Demo Program 2 (2022)

- 18 consortia funded
- 47 partners, 20 countries
- Total budget 3,37 M€

Sustainable services & business model



Digital Technologies, Advanced Robotics and increased Cyber-security for Agile Production in Future European Manufacturing Ecosystems (TRINITY)

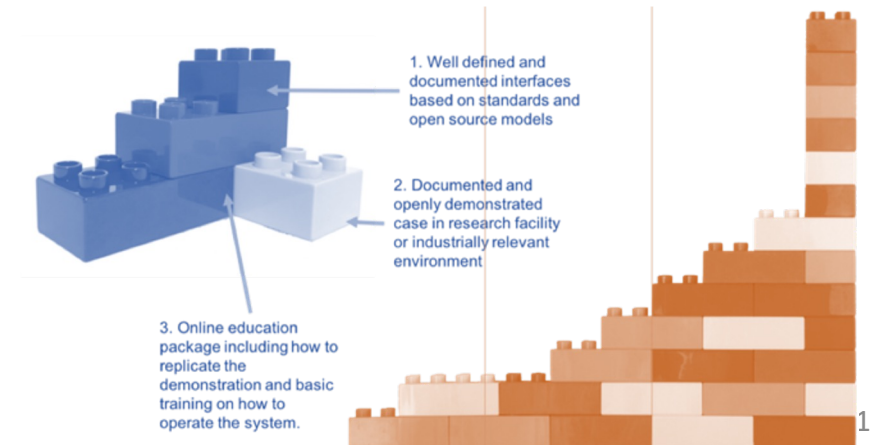
DT-ICT-02-2018 - Robotics - Digital Innovation Hubs (DIH)

Budget: 16,1 M€

Runtime: 1/2019-6/2023



Critical mass of use case demonstrations





Highlights from the H2020 TRINITY

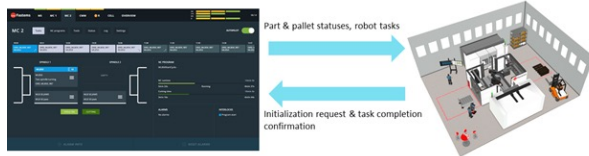
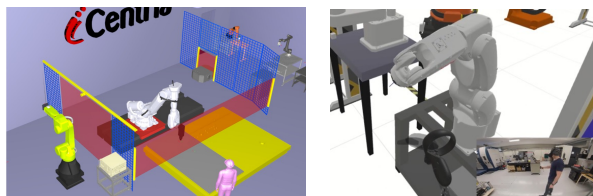
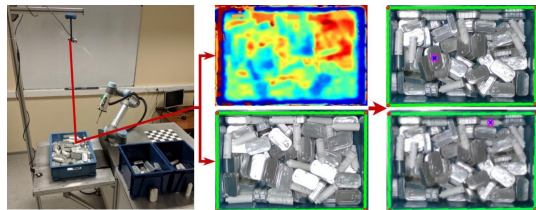
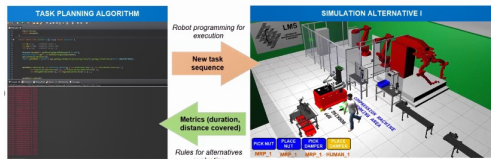
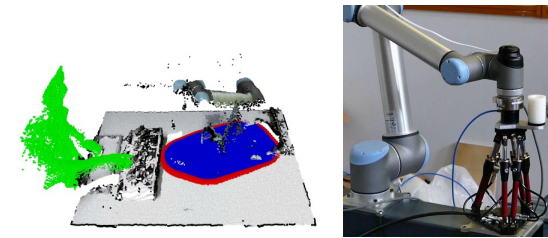
From Internal demonstrations



To Demonstration Program 1 Results



And to communication to the wider robotics developers and users



<https://trinityrobotics.eu>

TRINITY CATALOG

Use cases Modules

Filter

Name
Search

Owner of the demonstrator
Choose

NIACE
Choose

Keywords
Search

Benefits
Search

TRL
Choose

Sector of application
Search

Potential sector of application
Search

TRAINING of an Industrial Manipulator Using the MAGOS Platform - TRAINMAN-MAGOS
(Classification: Robotics, haptic-technology, robotic development time saving)

TRAINMAN-MAGOS is a system composed by a haptic-glove, a robot and a gripper. Its function is to translate hand movements performed with the haptic glove into a set of instructions. These instructions are then processed by the robot and the gripper, which could reproduce these movements, having thus the possi...

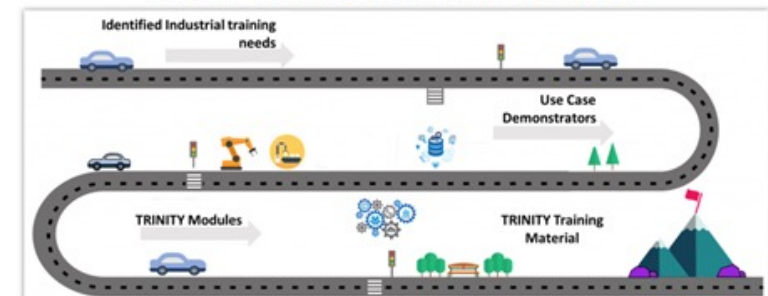
LEARN MORE

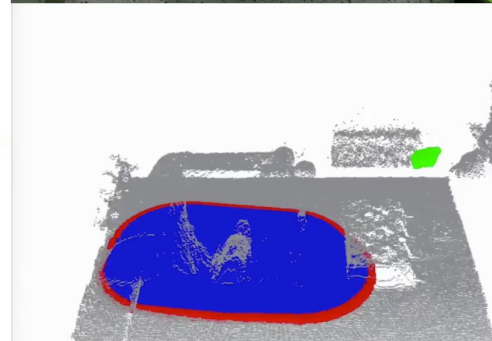
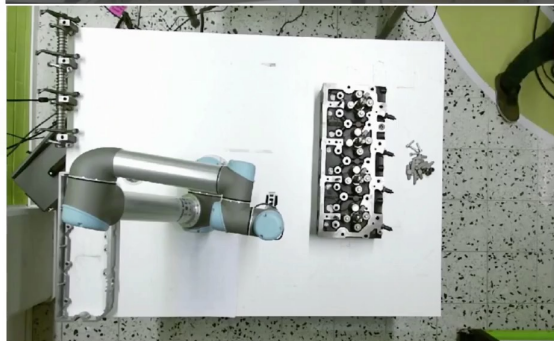
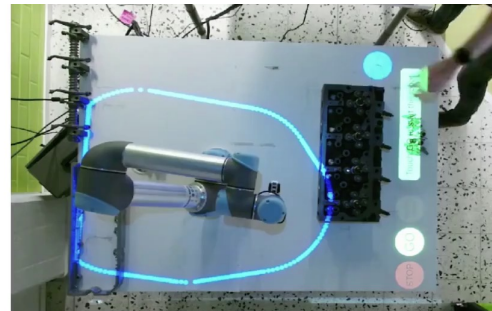
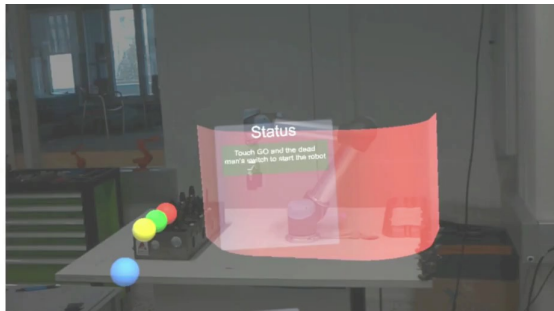
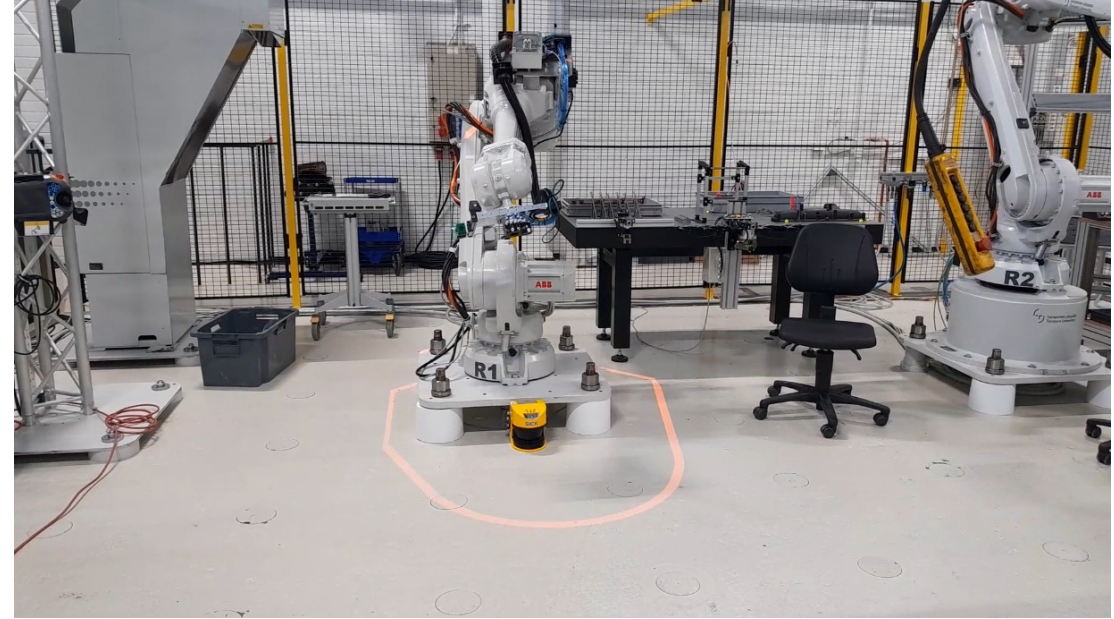
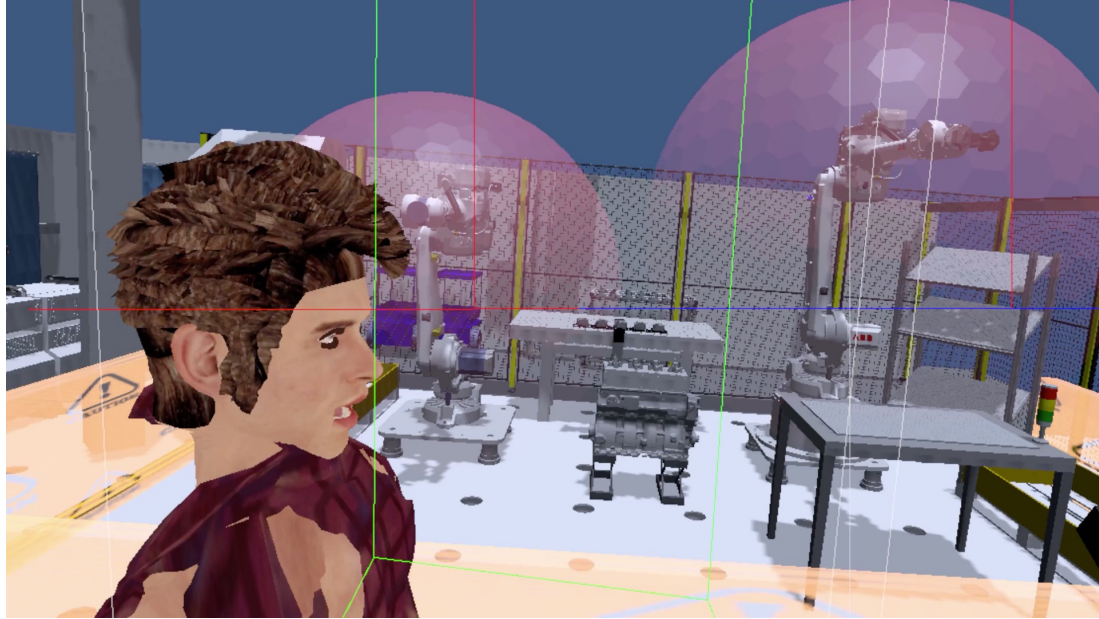
Standardised industrial robotic solution for metal bending automation

RoboBend introduces a standard robot that operates bending machines. An operator specifies the piece that needs to be bent through an easy-to-use user interface. This process is repeated only for new pieces since all information is stored and can be accessed from the cloud server. The robot picks up ...

LEARN MORE

TRINITY TRAINING PLATFORM ROADMAP





Collaboration examples from the companies

Collaboration between Fastems and Tampere University

- We host the FMS training center
 - Several courses utilise this environment in their education
 - We also offer factory visits for the student groups
- There are 6-9 masters' theses done annual basis
- We give introductory lectures to flexible manufacturing and machinery safety for BSc and MSc students yearly
- We have taken part to H2020 TRINITY research project as a core partner
- And we are involved in many Finnish nationally funded projects yearly
- We take part to advisory boards of different research projects and provide industrial view for the e.g. investment plans



Mr. Teemu-Pekka
Ahonen, Fastems
www.fastems.com

www.six.fi

<https://research.tuni.fi/virtualfms/>

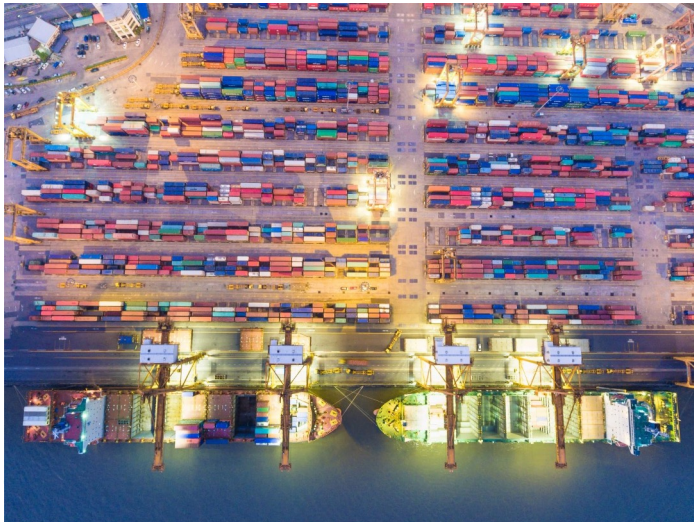


Collaboration between Cargotec and TAU



DSII Doctoral School
of Industry Innovations

Dr. Juho Vihonen
Technical Lead, Automation AI
juho.vihonen@cargotec.com
www.cargotec.com



Cargotec optimises global cargo flows and creates sustainable customer value through electrification, robotisation and digitalisation. Cargotec's sales in 2021 totalled to €3.3B and it employs about 11.000 people.

- We complete several masters' theses annually company wide
- We offer company visits for engineering students and research academics
- We are involved in many national and EU funded projects yearly
- We frequently engage bi-lateral research services from TAU
- We combine research and innovation via DSII (Doctoral School for Industry Innovation, <https://www.dsii.fi>)

Foreseeable research areas in the domain of intelligent systems include mobile manipulation, sustainable autonomy, metaverse for robots and mixed mode operations, see, e.g., this [video](#).

Conclusions

- The collaboration is in different levels
 - Basic level: Factory visits, introductory lectures
 - Intermediate level: BSc & MSc education, group works, MSc theses
 - Advanced: National and International collaborative projects
 - Advanced+: Own doctoral students (e.g. DSII in Finland)
- Shared Facilities
 - Should be designed together to maximize the potential Test and Experiment facilities or Pilot Lines
 - Real industrial cases with University build SW&HW prototypes
 - Co-ownership to ensure the longevity of the facilities (and maintenance of the equipment)



SIE Sustainable Industry Ecosystem

Many thanks!

