

trinity

REILUSTI ROBOTIIKKA TEOLLISUUS X, 16.11.2021

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Tampereen yliopisto

 www.trinityrobotics.eu



The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

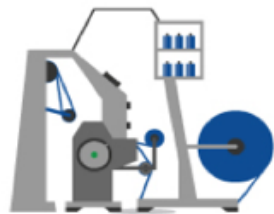
Late 18th century

Beginning of 20th century

1970s–2000s

2010 onward

Teollisuuden vallankumoukset



First industrial revolution: Power generation

- Introduction of the power loom in 1784
- Mechanization of production facilities with water and steam power



Second industrial revolution: Industrialization

- Introduction of the assembly line in slaughterhouses in 1870
- Electrification drives mass production in a variety of industries



Third industrial revolution: Electronic automation

- Development of the first programmable logic controller (PLC) in 1969
- Growing application of electronics and IT to automate production processes



Fourth industrial revolution: Smart automation

- Increasing use of cyber-physical systems (CPS)
- In January 2011, Industry 4.0 was initiated as a "Future Project" by the German federal government
- With the introduction of IPv6 in 2012, virtually unlimited addressing space becomes available
- Governments, private companies, and industry associations have been focusing on Industry 4.0 and making investments since the 2010s

Sources: Germany Trade & Invest, "INDUSTRIE 4.0—Smart manufacturing for the future," July 1, 2014; National Academy of Science and Engineering, "Securing the future of German manufacturing industry: Recommendations for implementing the strategic initiative Industry 4.0," April 2013; Deloitte analysis.

Teknologia- harppauksia:

Communication
Connectivity
Interfaces
Protocols
Sensors
Data collection
Platforms
Data sharing
Regulations
Human-centricity

The F4IR project has received funding from the European Union's Horizon 2020 Research and Innovation programme under the GA 825196

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.

24%



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

The robot sensor market will experience a CAGR (compound annual growth rate) of

10% through 2026

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

2030



Sectors to Watch



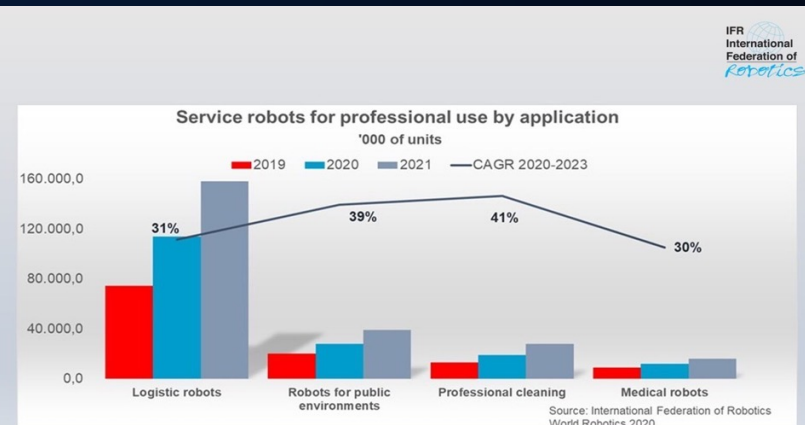
Ref: <https://hokuyo-usa.com/resources/blog/what-expect-mobile-robotics-industry-2021>



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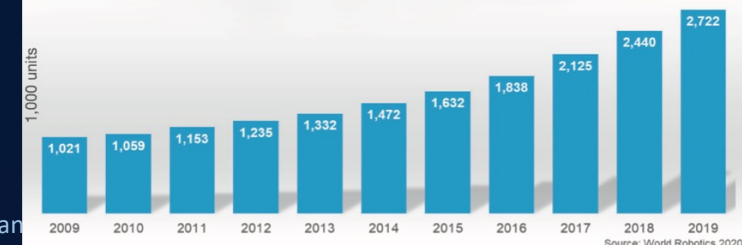
Key technology trends covered:

- 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"



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1970s–2000s

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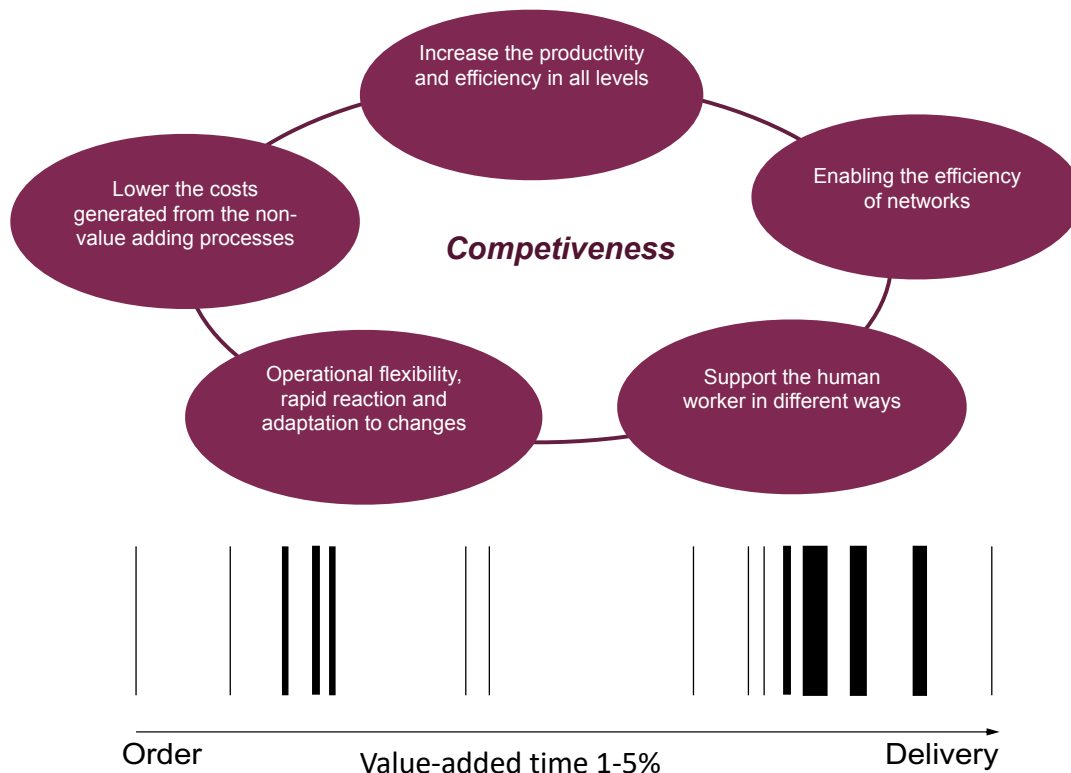
Dankert, Clyde E. "Automation and Unemployment," Studies in Unemployment.
U.S. Senate, Special Committee on Unemployment Problems, 86th Cong.,
2d sess. (Washington, U.S. Government Printing Office, 1960), pp. 225-
250.
Concept of automation and effects feared. Definitions and characteris-
tics of technological unemployment and policy suggestions for coping with
it. Impact of technological change on employment.

Denise, Malcolm L. "Statement before the Subcommittee on Unemployment
and the Impact of Automation," Impact of Automation on Employment;
Hearings, U.S. House of Representatives, Committee on Education and
Labor, 87th Cong., 1st sess., April 17, 1961 (Washington, U.S.
Government Printing Office, 1961), pp. 509-574.

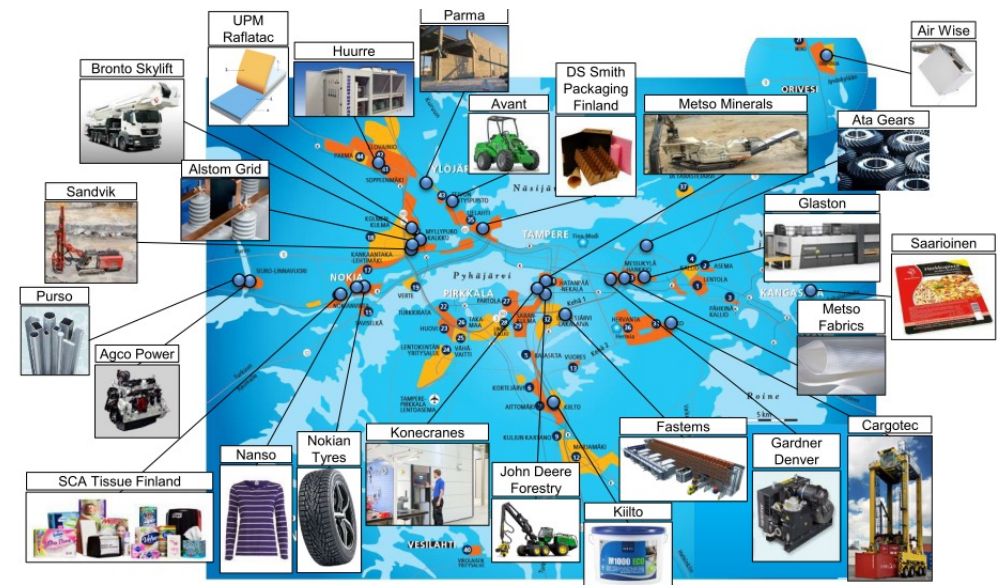


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Reunaehdot teknologian kehitykselle



Teollisuus4.0: Yhden kappaleen erä koko taloudellisesti kannattavaksi!



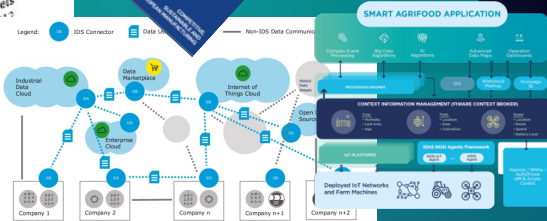
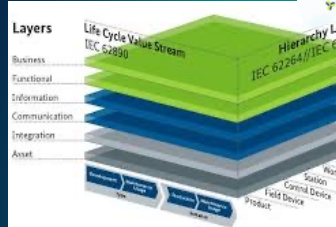
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TRINITY AGILE MANUFACTURING

19.11.

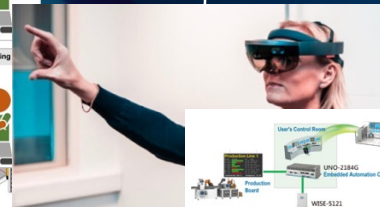
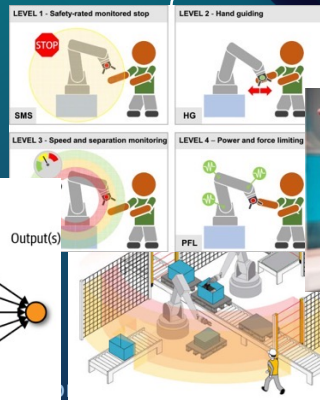
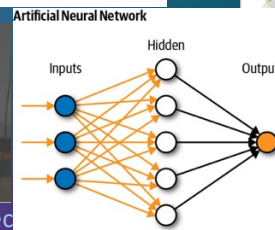
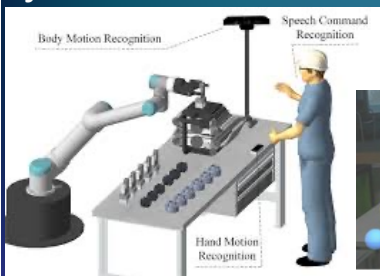
Pari pientä lisähaastetta

Hienoja visioita

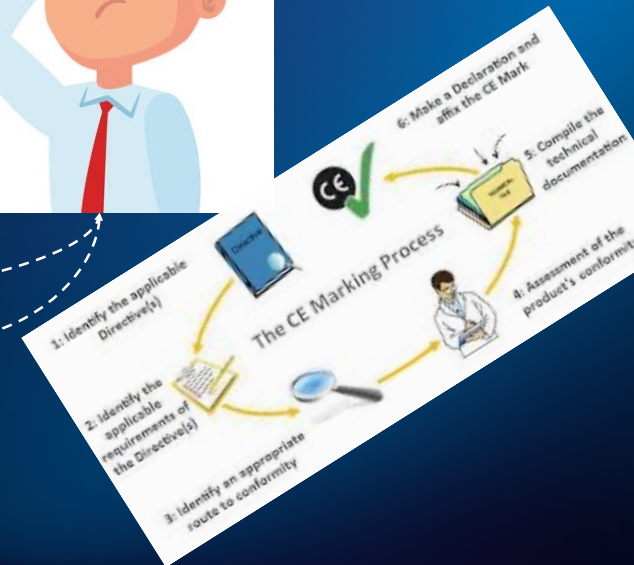


Uusia alustoja

Teknologiaa oikealta ja vasemmalta



Toimiikohan se?
Osataankohan me?



trinity ENGAGE WITH AGILE MANUFACTURING

on programme under the GA 825196

Hypoteesi robotisoinnille, digitalisoinnille ja yhteistyölle

Increase the product quality and production capacity by robotics

Mundane tasks for robots (e.g. dirty, dull and dangerous tasks)

Transform (human) operator to knowledge worker and problem solver (e.g. system supervisor)

Ensure that the factories can operate with less engineers (since we will lack those)

Shorten the overall production time with ICT and AI

Increase supply network transparency

Realise reliable real-time data collection

Predict and prepare for continuous changes

Benefit from industrial ecosystems (e.g. DIHs)

Share resources, capacity and expertise

Answer together to the changing customer needs

Support the life-long learning and digital capability building

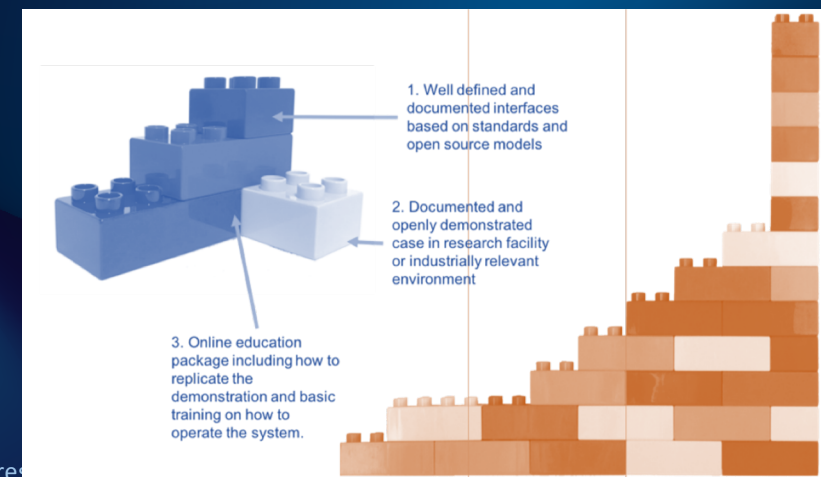
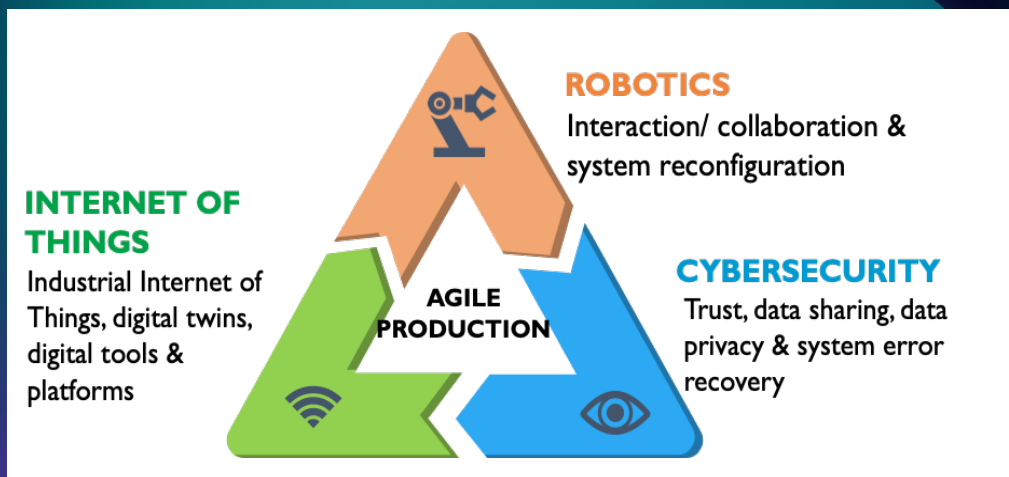


H2020 TRINITY 2019-2023

The main objective of TRINITY is to create a **network of digital innovation hubs (DIHs)** composed of Research Centres and University Groups specialized in Advanced Robotics and Internet of Things (IoT), supported by a DIH with experts in Robotics Cyber security to contribute to novel robotics solutions that will increase agility in production.

The second objective is to continue this network after the ramp-up phase, by building a **sustainable business model** throughout the project lifetime.

The third objective is to deliver a **critical mass of use case demonstrations** in collaboration with industry to support the industrial modernization leading to more agile production and increase the competitiveness of European companies.



Demonstraatioiden sijoittuminen teemoihin

* koostuvat erillisestä 32 teknologiamoduulista

#	Use Case Demonstrator	Rob.	IIoT	CS
1	Vision-based safety in collaborative assembly			
8	Efficient robot programming by demonstration			
11	Robotized serving of automated warehouse			
13	Mobile robots in collaborative work cells			
2	AR interaction in collaborative disassembly			
3	Collaborative robotics in larger scales			
4	AR/VR-based enhancement of the digital twin			
5	Wire arc additive manufacturing with robots			
7	Robot workcell reconfiguration			
10	HRI framework for operator support			
12	User-friendly programming of HRC tasks			
17	AI-based object pick-up by a robotic arm			
6	Production flow simulation/supervision			
9	Dynamic task planning & work re-organization			
14	Robot cell virtualization			
15	IIoT Robustness Simulation			
16	Flexible automation for agile production			
18	Rapid development of large scale WSNs			



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H2020 TRINITY 2019-2023

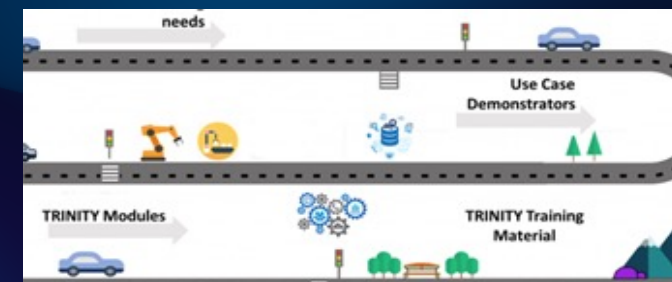
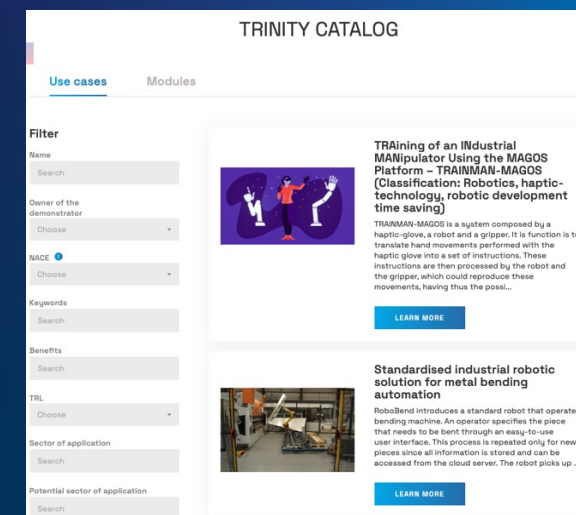
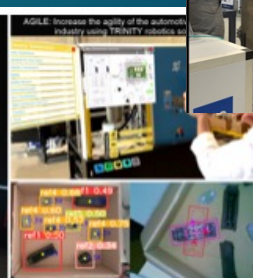
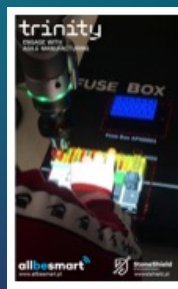
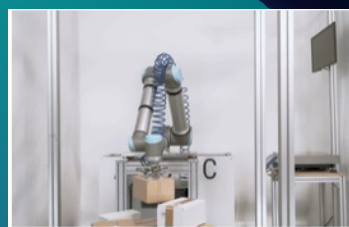
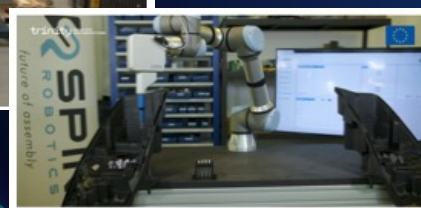
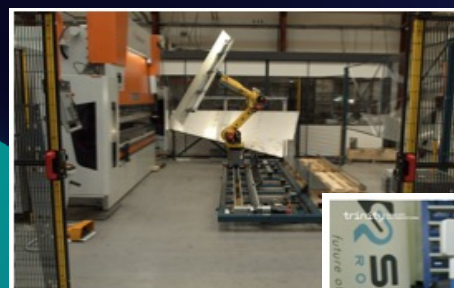
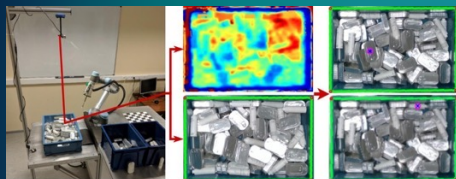
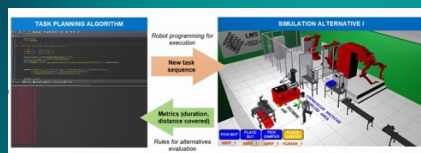
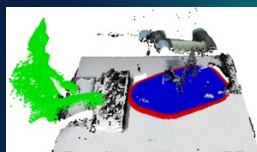
From Internal demonstrations



To Demonstration Program 1 Results

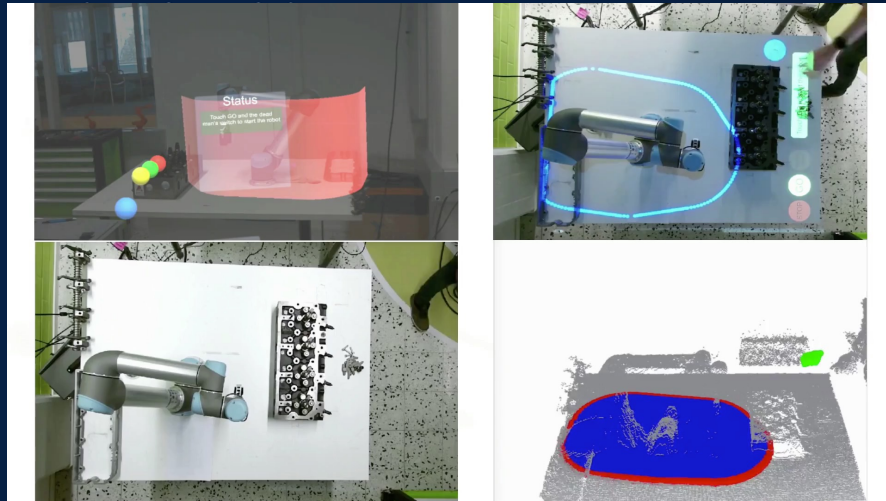


And to communication to the wider robotics developers and users

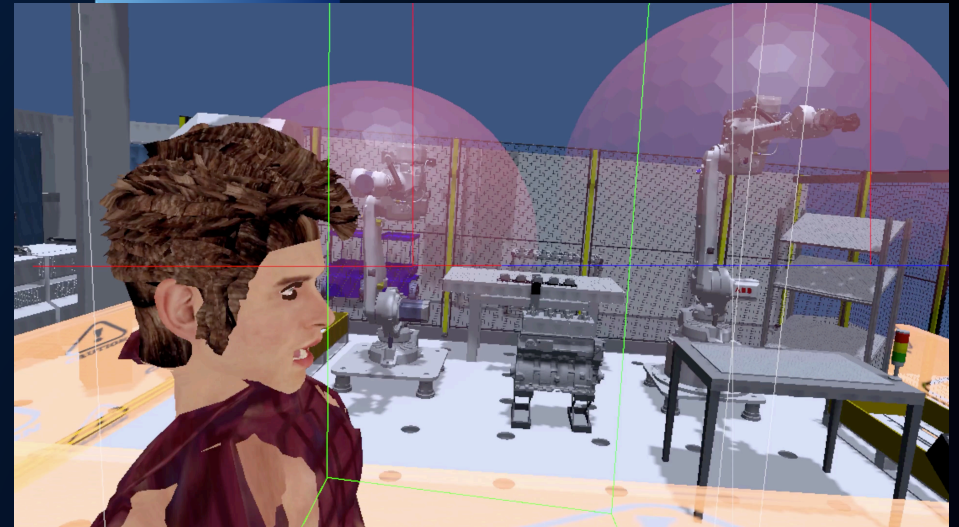


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Uusia käyttöliittymiä ihmisen ja koneen väliseen yhteistyöhön



Työturvallisuuden kouluttaminen VR:n avulla



Viestiminen valoilla ihmiselle

Digitaalisten
kaksosten
hyödyntäminen
robotiikassa

<https://youtu.be/qoQ2jFiy51g>

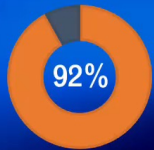


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TRINITY Demonstration Program 1, results in YouTube



EACHPack Demonstration Purposes



Small packages below 5kg



To create a complete
robotized handling system for
parcel sorting

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The number of
shipments is
increasing

Profit margin
is decreasing



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	Executive video ARGRIND Trinity Project TRINITYRobotics 7:26
	Executive Summary LOMSAS Trinity Project TRINITYRobotics 4:49
	Executive Summary ICON Trinity Project TRINITYRobotics 5:42
	Executive Summary SNIPE Trinity Project TRINITYRobotics 6:46
	Executive Summary EACHPack Trinity Project TRINITYRobotics 5:49
	Executive Summary ROBObEND Trinity Project TRINITYRobotics 6:10
	Executive Summary TRAINMAN MAGOS Trinity Project TRINITYRobotics 6:45
	Executive Summary Digi SAAP Trinity Project TRINITYRobotics 8:08
	Executive Summary of AGILE Trinity Project TRINITYRobotics 5:21
	Executive Summary of Affective Manufacturing System Trinity Project TRINITYRobotics 8:42

TRINITY Training Platform



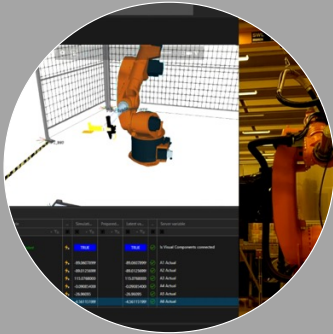
- Ilmaisia opetusmateriaaleja TRINITY Moduuleista and Use Case:sta
- Paljon muuta tietoa joustavan ja robotisoidun valmistuksen teknologioista
- Videomateriaalia tarjolla, ja lisää tulossa

<https://trinity-trainingplatform.eu/>

The screenshot displays the TRINITY Training Platform interface. It features a 'Modules' section on the right with three items: 'MTM UNIVERSAL ANALYSIS SYSTEM (UAS)' by Montagetchnik GmbH, 'DYNAMIC TASK PLANNING & WORK RE-ORGANIZATION MODULE' by LMS, and 'SAFETY LOGIC FOR SEAMLESS HRC' by LMS. Below these is 'AR BASED OPERATOR SUPPORT IN HRC' by LMS. A 'Wearable AR-based Interaction Interface for HRC' section shows a video of a person using a wearable device. The left side shows two use cases: 'COLLABORATIVE ASSEMBLY WITH VISION-BASED SAFETY SYSTEM' and 'COLLABORATIVE ROBOTICS IN LARGE SCALE ASSEMBLY, MATERIAL HANDLING AND PROCESSING'. Both use cases include a video player and a 'CLICK HERE FOR MORE INFORMATION' button. The bottom right corner features the TRINITY logo and the text 'ENGAGE WITH AGILE MANUFACTURING'.



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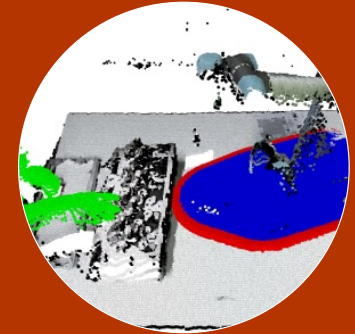
Intuitive and multi-modal programming environment: workers do not need prior in-depth knowledge of the system,



Zero-programming: ideally, the workers can work with the robots via gestures, voice commands, and other forms of natural input without the need of coding



Immersive collaboration: with the help of different devices, e.g. screens, goggles, wearable displays, the worker can collaborate with the robots with actively engaged senses



Context/situation dependency: the system should be capable of interleaving autonomous human with robot decisions based on trustworthy inputs from on-site sensors and monitors inspecting both humans and robots.

Tulevaisuuden kehityssuuntia robotiikassa 2025-2030



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 @TRINITY Robotics DIHs

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Thank you!

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