Applied AI in Industrial Automation in EC projects **THOMAS** and **ODIN**

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The Problem

Factories struggle to follow the market demand for new products

Fixed automation is efficient only for mass production

- Processes are predetermined
- Robots & machines in fixed position & pre-programmed
- Costs time and effort to introduce new product variants

Full manual production creates strain to workers

- **7.6 million people** must lift and carry heavy loads
  - Musculoskeletal disorders (MSD)
  - High work absenteeism reasons → production downtimes

Current Practices

Industrial practice

- High payload Industrial robot in fences
- No collaboration among varying resource types
- AGVs follow fixed navigation paths
- Production stops due to lack of consumables

Automated Guided Vehicles

Industrial robots in cages

R&D practice

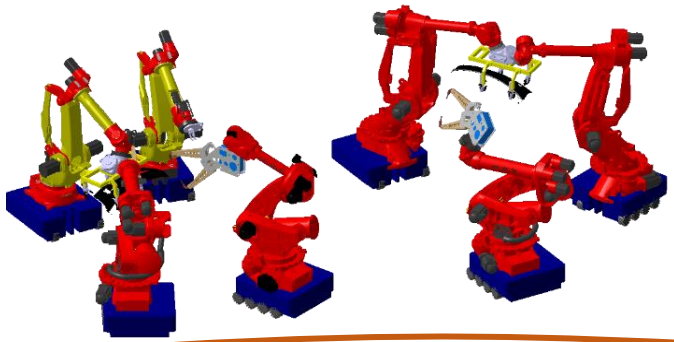
- Only low payload collaborative robots
- Mobile manipulators face poor acceptance in industrial settings
- Research on the individual parts neglecting real use cases
- Lack of perception abilities

Source: MM-500, Neobotix.

Collaborative low payload robots

New Assembly paradigm

- Eliminated fixed tooling and jigs
- Flexible and exchangeable tooling
- Robot arms on mobile platforms
- Ability to collaborate with humans



THOMAS

Mobile dual arm robotic workers with embedded cognition for hybrid reconfigurable manufacturing systems

Visit our website: www.thomas-project.eu

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(Project Coordinator)

PSA GROUPE

INTRASOFT INTERNATIONAL

AERnnova

roboception

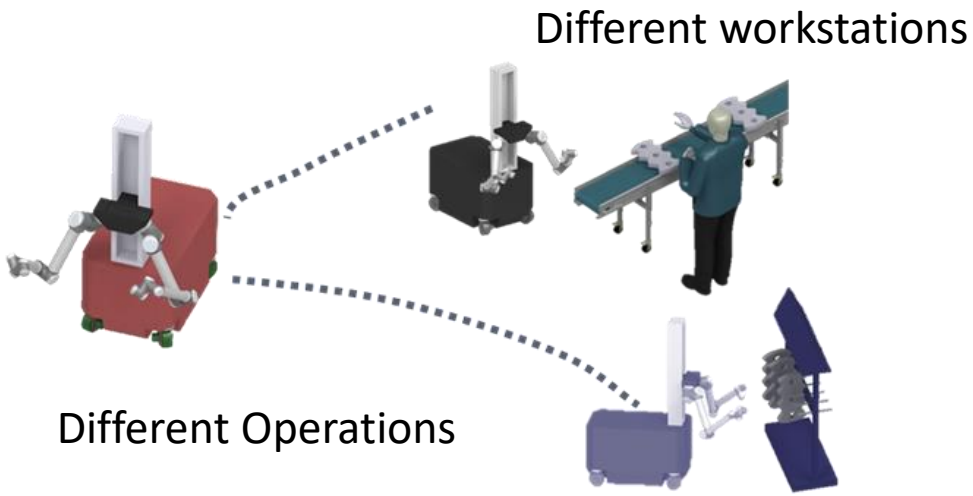
tecnalia Inspiring Business

SICK Sensor Intelligence.

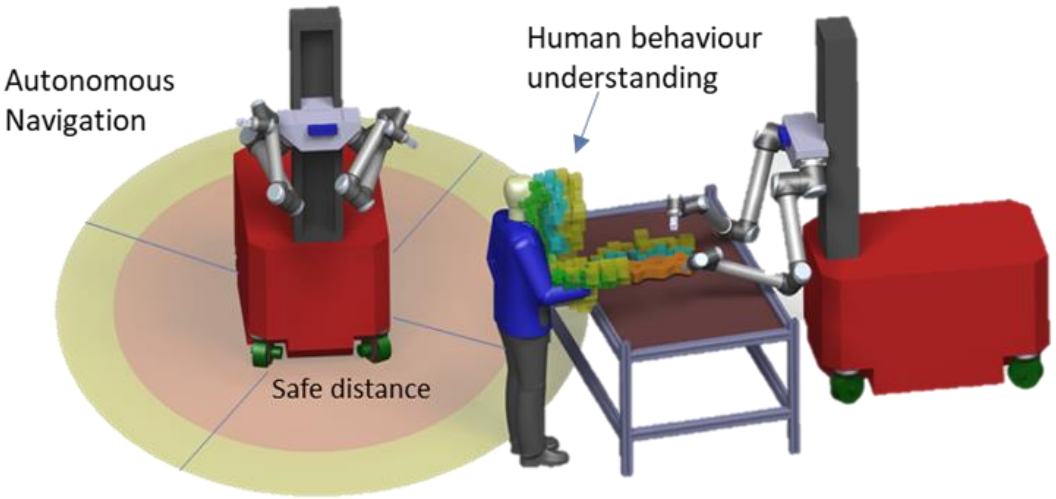
DGH ingeniería mantenimiento industrial

Dynamic Reconfigurable Factories

Flexible robot workers…

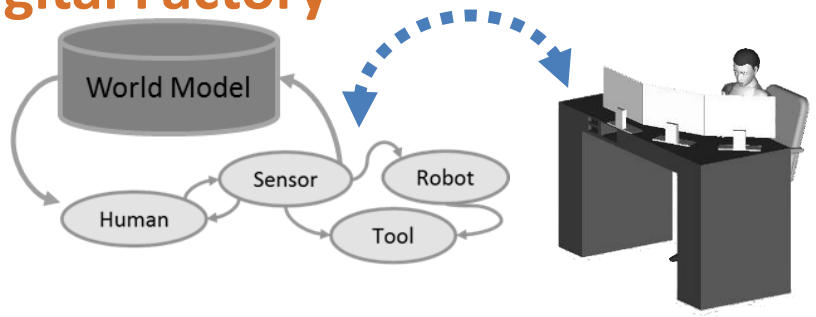


…acting as assistants to humans



… enabled by a Smart Robot Control System

Digital Factory

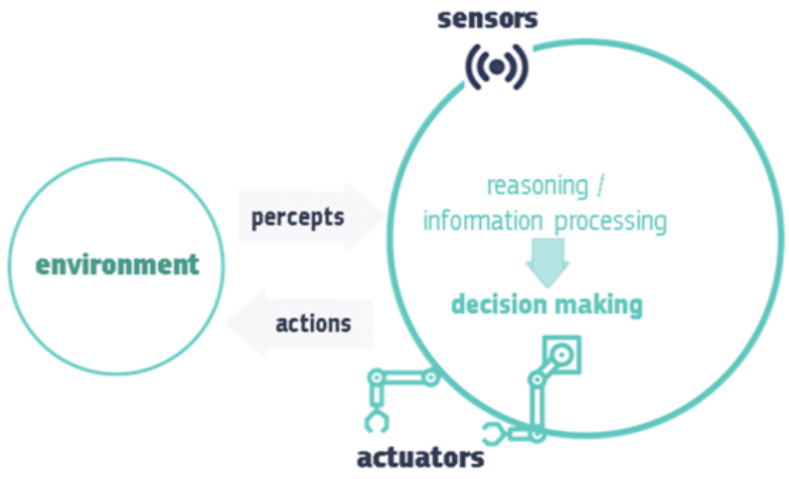


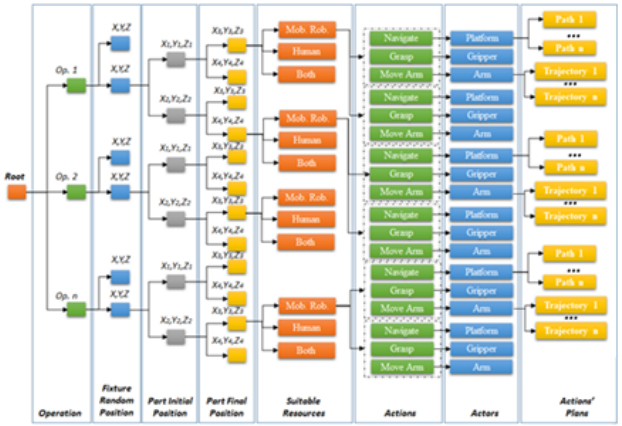
Artificial Intelligence

- Dynamic Task Planning
- Human behaviour understanding
- Robot Collision free trajectories

AI enabling Dynamic Reconfigurable Factories

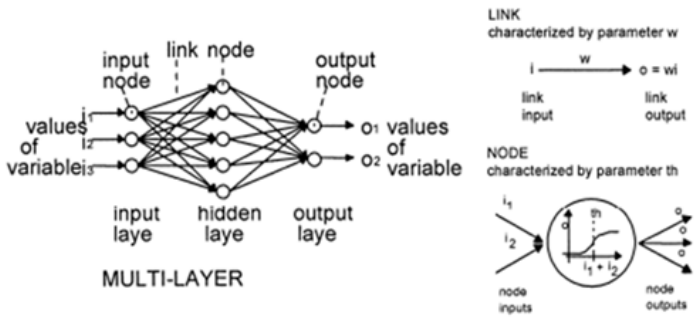
A schematic depiction of an AI system [1]

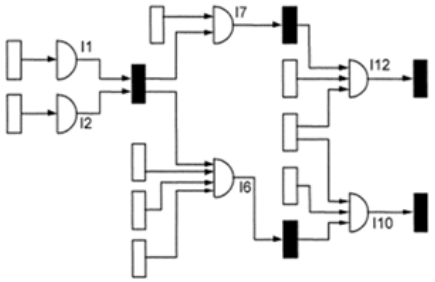




Search methods[2]

Neural networks-CNNs,...[2]





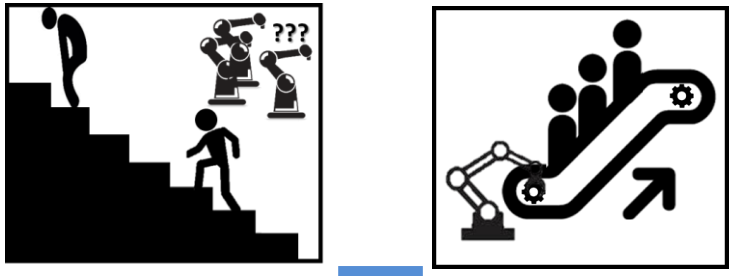
Rule based[2]

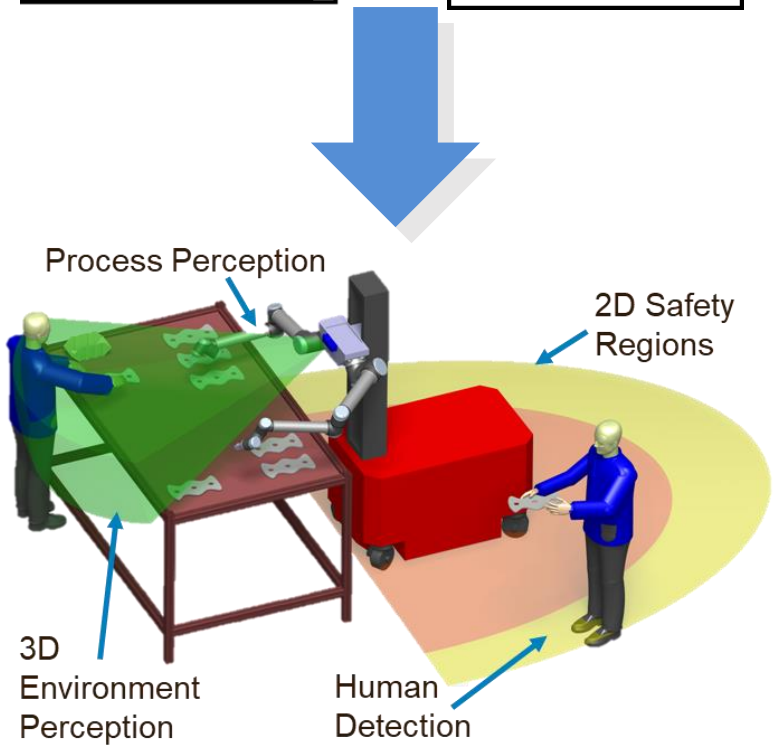
[1] HLG on AI, A DEFINITION OF AI:MAIN CAPABILITIES AND DISCIPLINES, 2019
[2] G. Chryssolouris, "Manufacturing Systems: Theory and Practice", 2nd Edition, 606p, Springer-Verlag, New York (2006)

Challenges

To enable system's **autonomy** and **reconfigurability :**

- Perception for the environment
- Perception for the process
- Perception for the human operators
- Where to find the required data?





Automotive pilot case

- ✓ **3 working areas – vehicles front axle assembly**
- ✓ **1 Mobile Robot Platform (MRP) assisting a human operator**
- ✓ **1 Mobile Product Platform carrying the base part - disk**

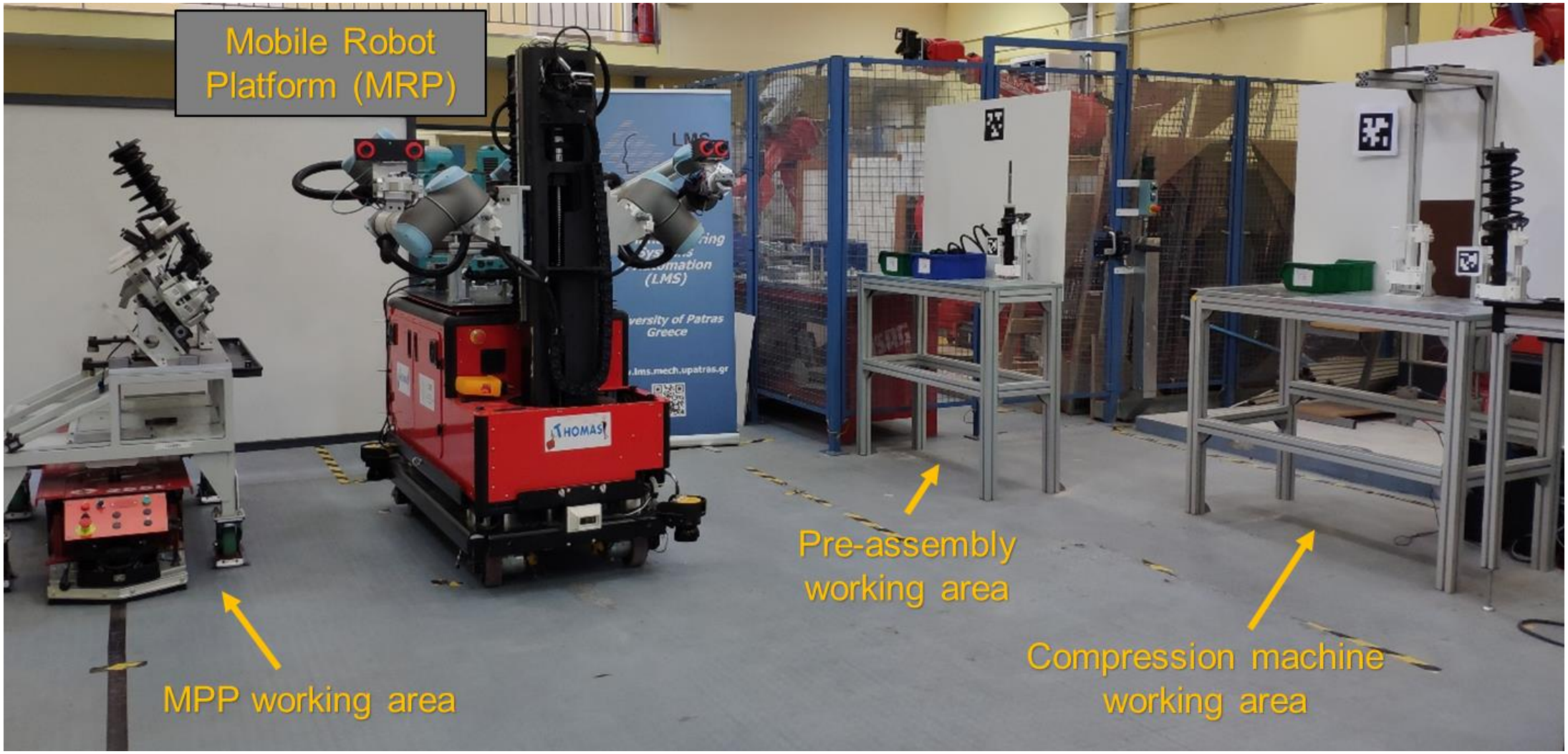
PSA GROUPE

DAMPER PRE-ASSEMBLY

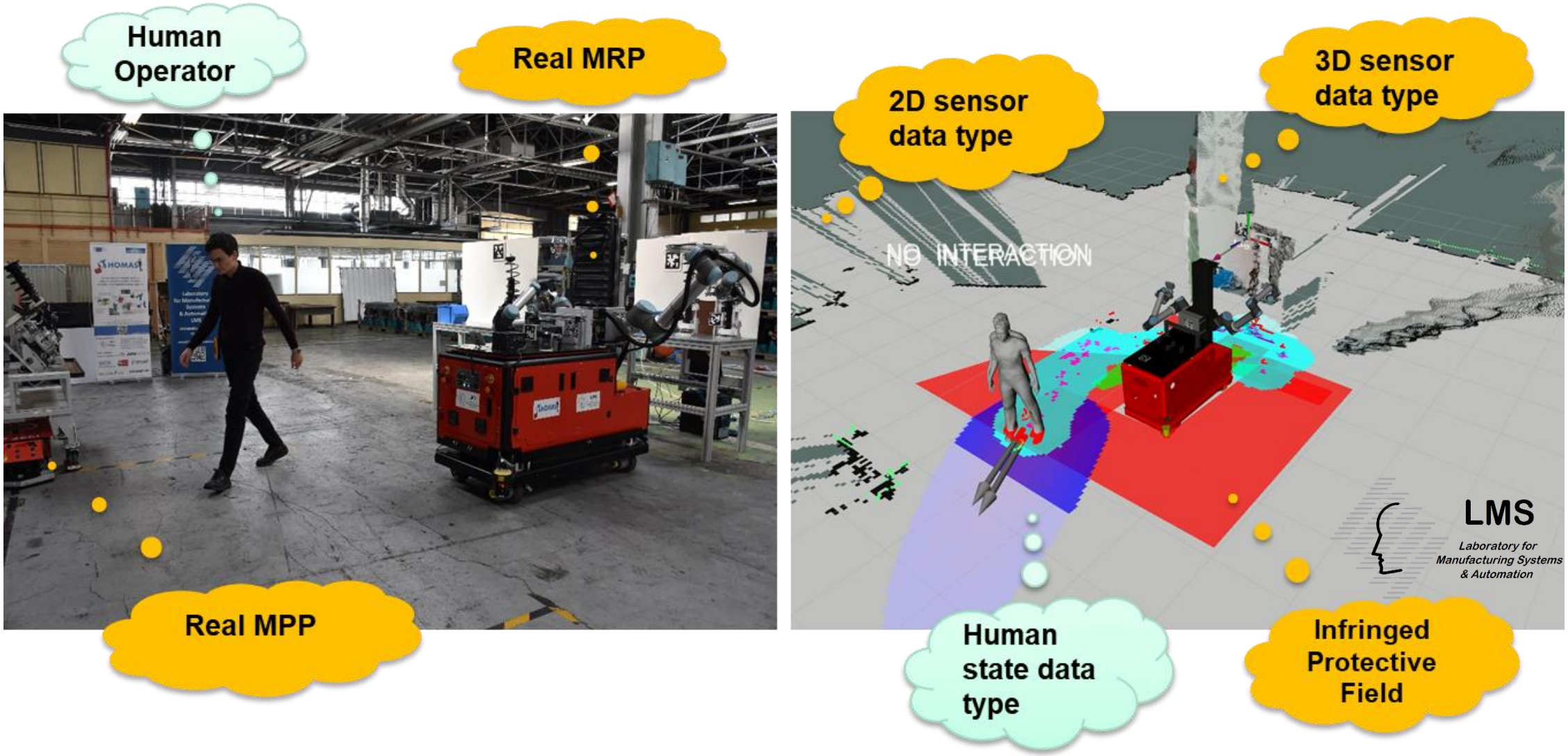
DAMPER COMPRESSION

DAMPER ASSEMBLY ON THE DISK

From LMS Machine Shop, Greece …



Digital Twin



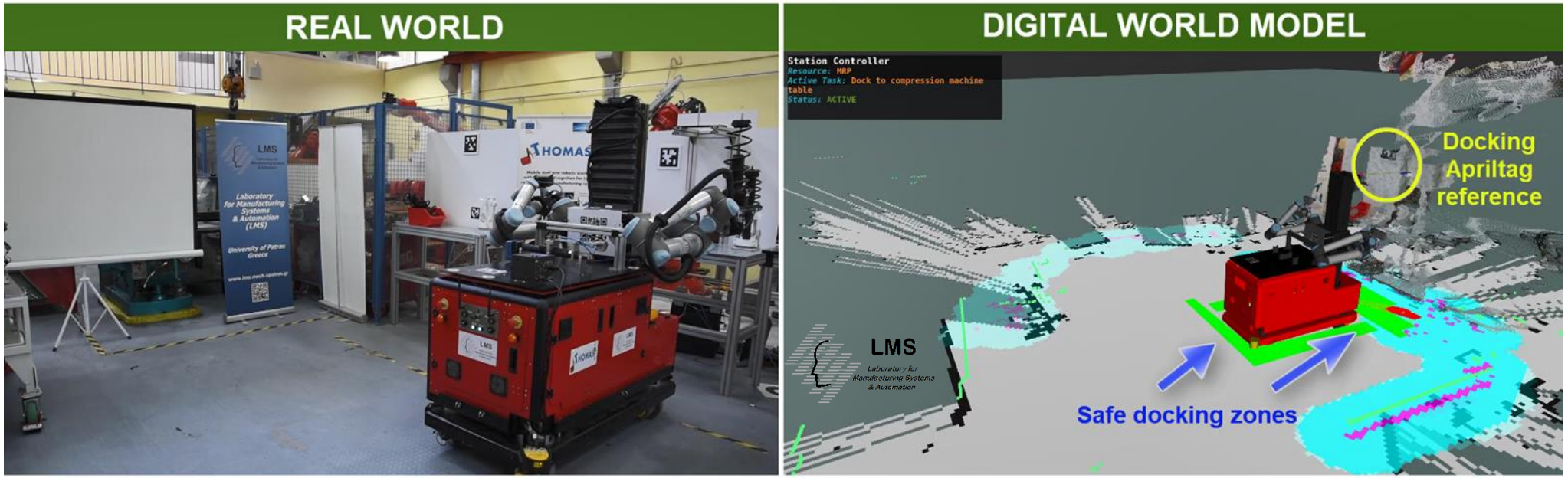
Perception for the Environment

Perception of the environment

Navigation (cell to cell) and **localization** (in-cell – safe)

ACCURACY ≈ 5 - 10 cm **ACCURACY ≈ 1 cm**

Safe Virtual Docking through 3D based localization



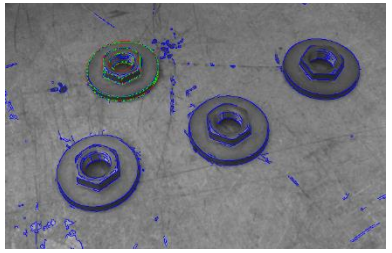
Perception for the Process

Perception of the process

End to end integration of:

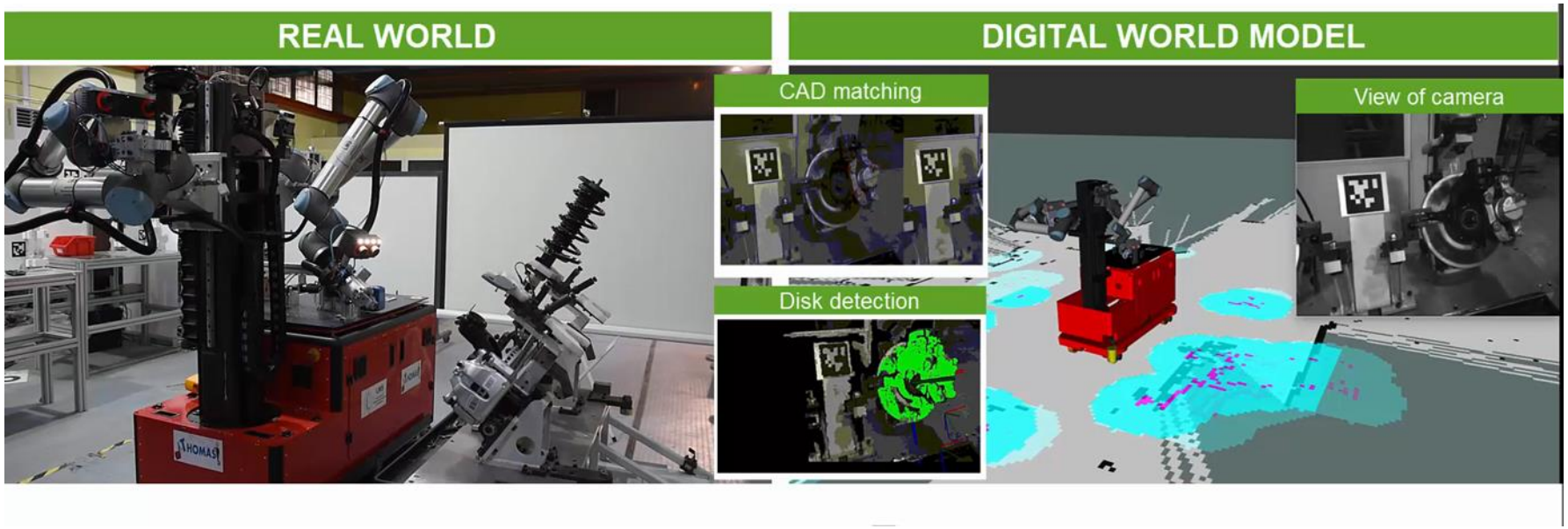
roboception

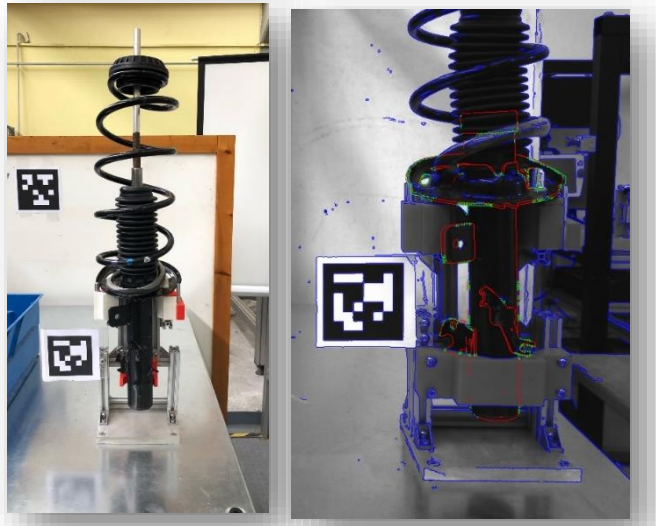
✓ **3D vision** systems enabling **process perception for manipulation**



Nuts

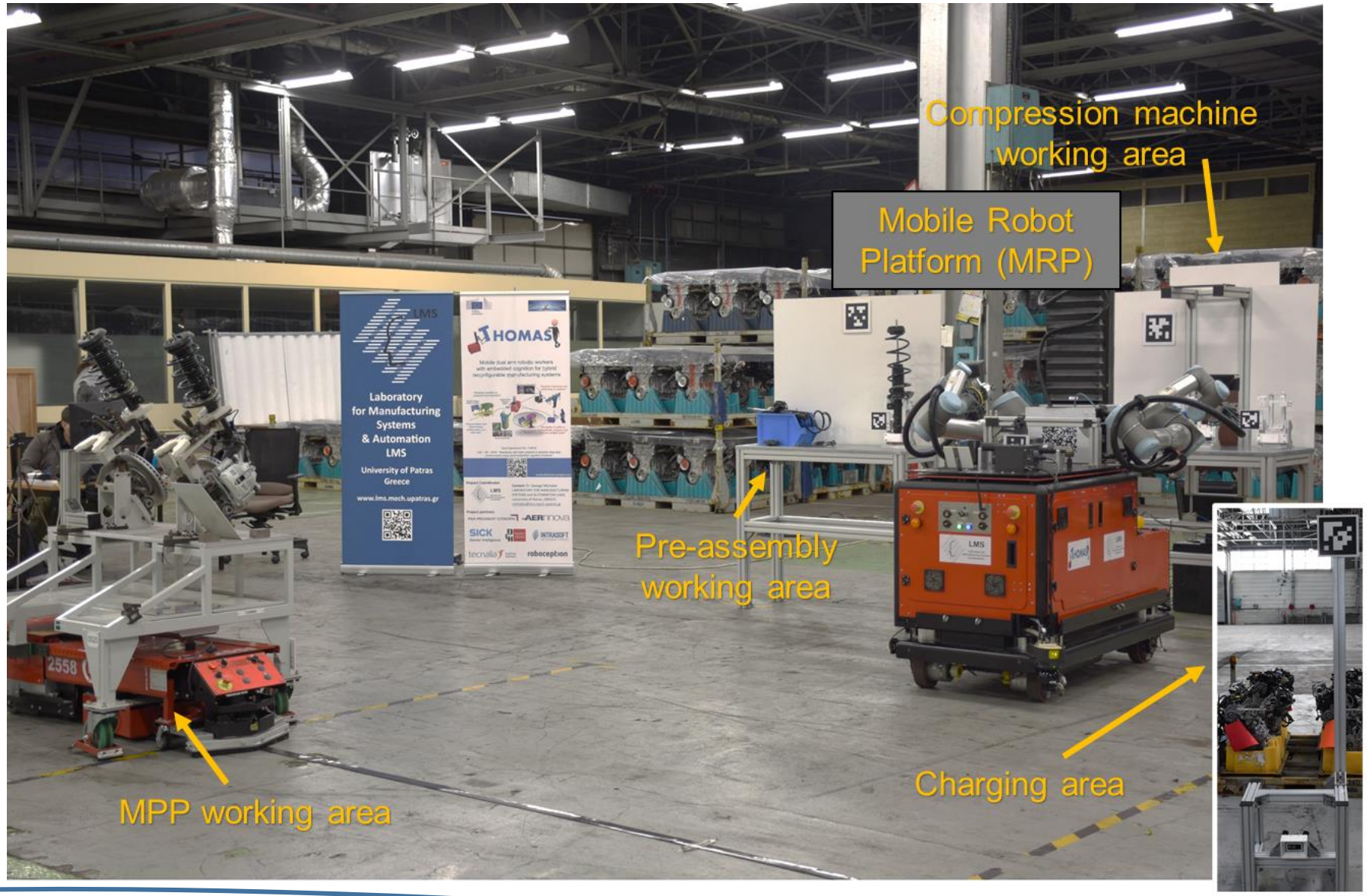
ACCURACY ≈ **15 mm translation**
10 deg. rotation





Pre-compressed damper's detection

… to STELLANTIS Mulhouse plant, France

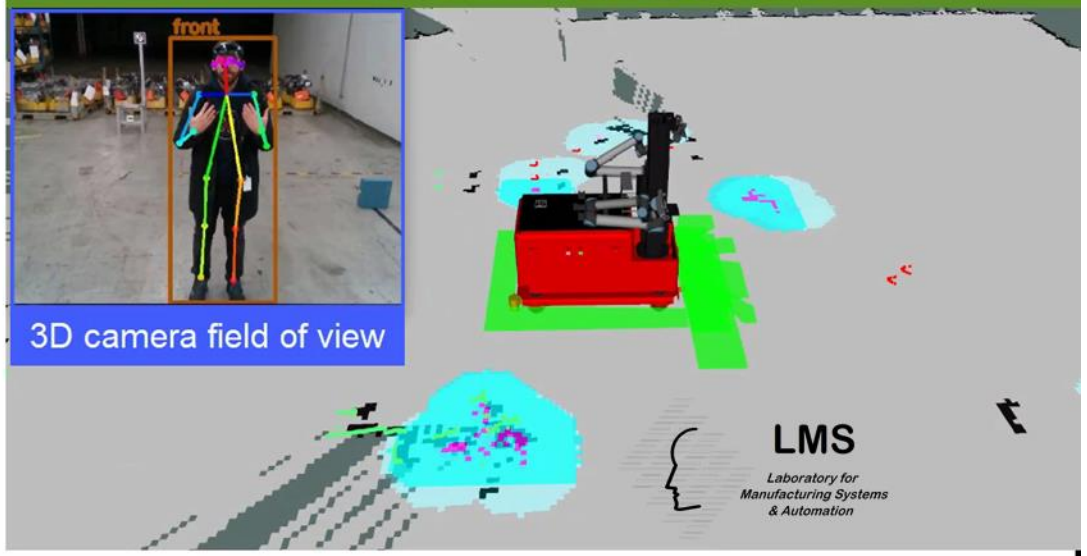


Perception for the Human

Human REMOTE INTERACTION state → **Gestures recognition control**

REAL WORLD

DIGITAL WORLD MODEL



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ODIN

Open – Digital – Industrial and Networking pilot lines using modular components for scalable production

Visit our website: http://odin-h2020.eu/

LMS Laboratory for Manufacturing Systems & Automation (Project Coordinator)

tecnalia Inspiring Business

KTH VETENSKAP OCH KONST

COMAU

PILZ THE SPIRIT OF SAFETY

roboception

VISUAL COMPONENTS

INTRASOFT INTERNATIONAL

S21sec

aic AUTOMOTIVE INTELLIGENCE CENTER

ingeniería mantenimiento industrial

STELLANTIS

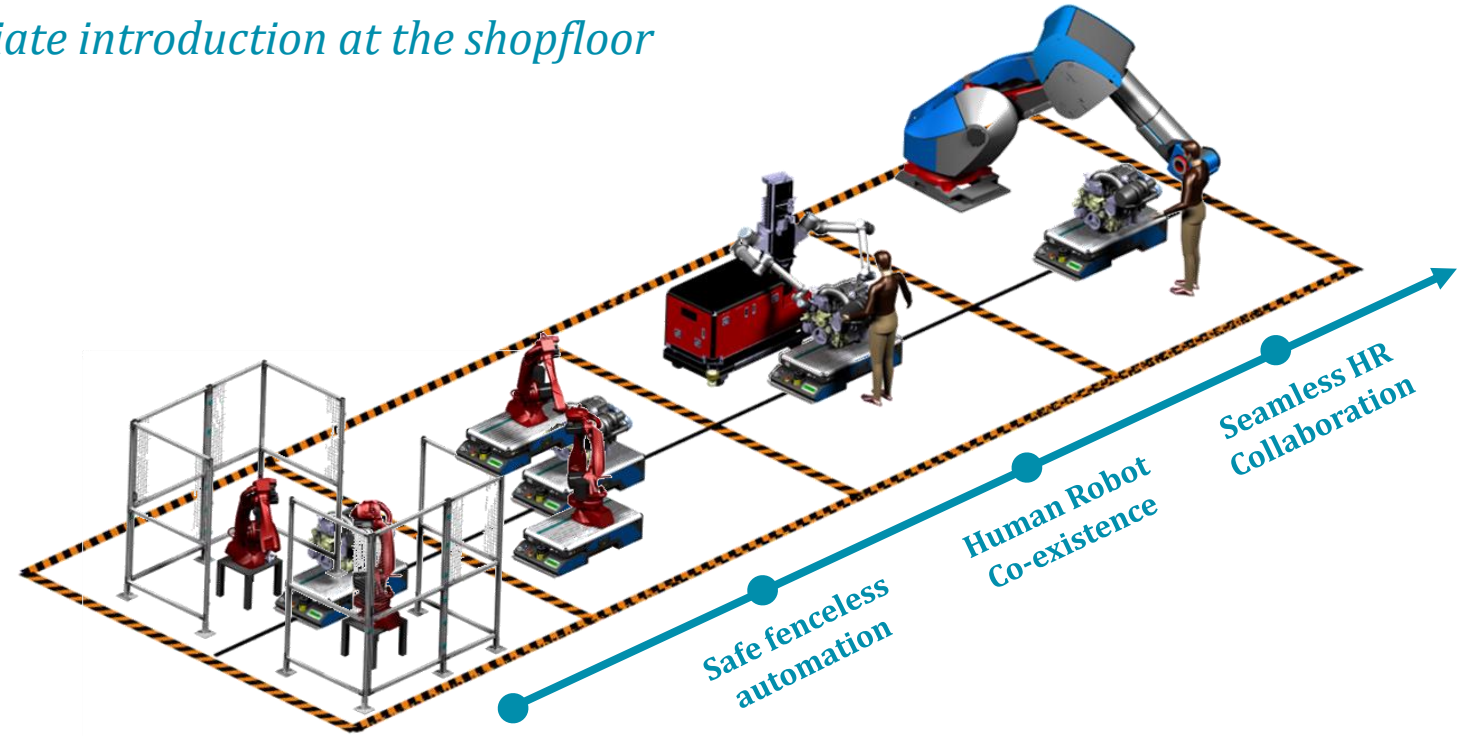
aerotecnic

Whirlpool CORPORATION

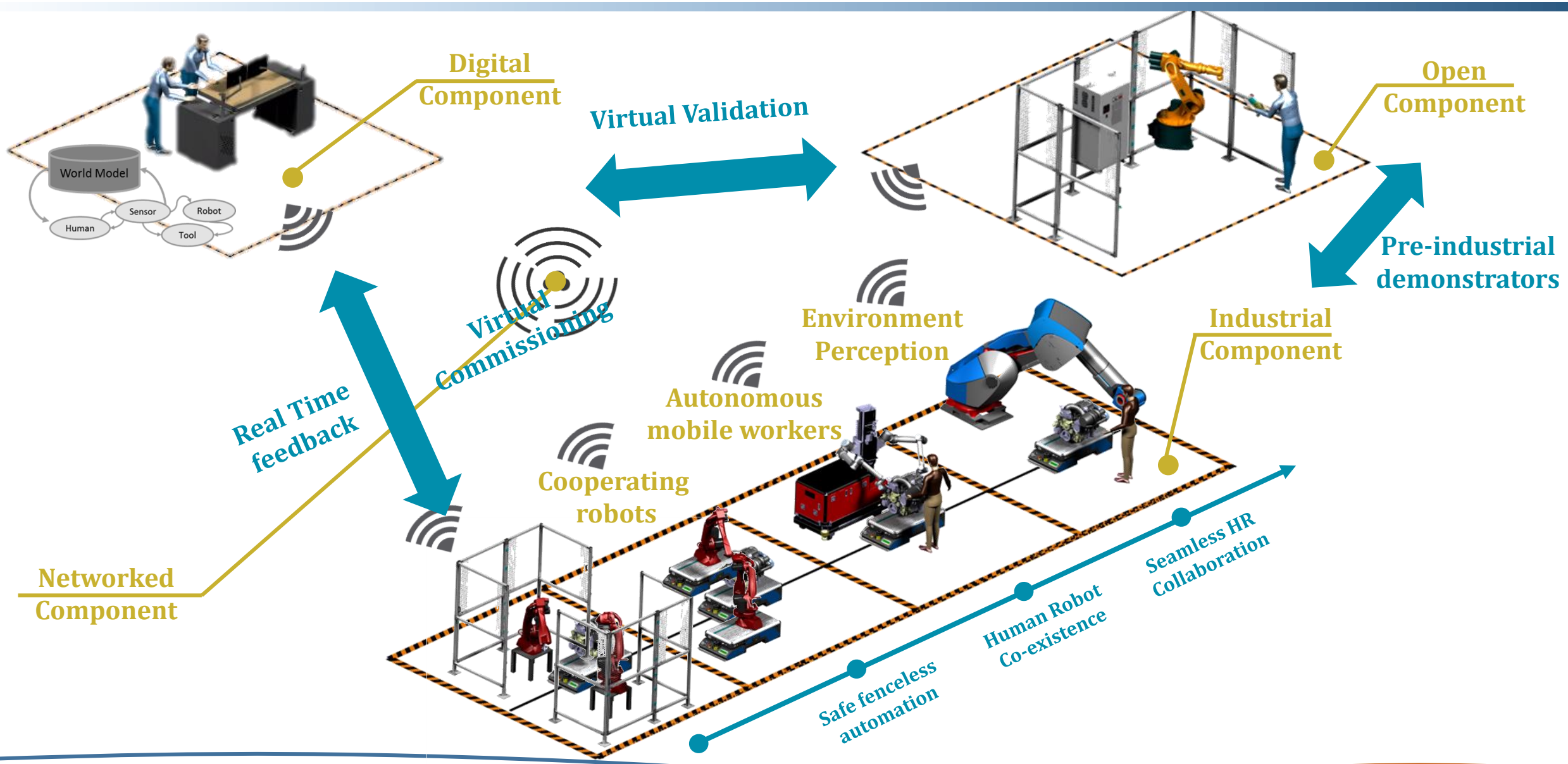
ODIN Ambition

How to integrate these modern robot capabilities?

ODIN vision is to *demonstrate that these modern robot capabilities are not only technically feasible, but also efficient and sustainable for immediate introduction at the shopfloor*



ODIN Approach



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Thank you for your kind attention!

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