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

## 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

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

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**Source:** MM-500, Neobotix.

**Collaborative low payload robots**

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**Automated Guided Vehicles**

**Industrial robots in cages**
Mobile dual arm robotic workers with embedded cognition for hybrid reconfigurable manufacturing systems

Visit our website: www.thomas-project.eu

(Project Coordinator)
Dynamic Reconfigurable Factories

Flexible robot workers...

Different workstations

Different Operations

...acting as assistants to humans

Autonomous Navigation

Human behaviour understanding

Safe distance

... enabled by a Smart Robot Control System

Digital Factory

Artificial Intelligence

World Model

Sensor

Human

Robot

Tool

Dynamic Task Planning

Human behaviour understanding

Robot Collision free trajectories

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AI enabling Dynamic Reconfigurable Factories

A schematic depiction of an AI system

Search methods

Neural networks-CNNs...

Rule based

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1 HLG on AI, A DEFINITION OF AI: MAIN CAPABILITIES AND DISCIPLINES, 2019

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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
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:

✓ 3D vision systems enabling process perception for manipulation

ACCURACY ≈
- 15 mm translation
- 10 deg. rotation

Pre-compressed damper’s detection

Nuts
... to STELLANTIS Mulhouse plant, France
Perception for the Human

Human REMOTE INTERACTION state  →  Gestures recognition control

REAL WORLD

DIGITAL WORLD MODEL

3D camera field of view

LMS
Laboratory for Manufacturing Systems & Automation

PSA
GROUPE

INTRASOFT
INTERNATIONAL

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

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

- Networked Component
  - Real Time feedback
- Digital Component
  - Virtual Validation
- Open Component
  - Pre-industrial demonstrators
- Industrial Component
- Pre-industrial demonstrators
- Digital Component
- Virtual Commissioning
- Autonomous mobile workers
- Environment Perception
- Coordinating robots
- Seamless HR Collaboration
- Safe fenceless automation
- Human Robot Co-existence

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References


Thank you for your kind attention!

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