



Decision making in dynamic reconfigurable shopfloors using mobile robots as assistants to human operators

THOMAS EU Project

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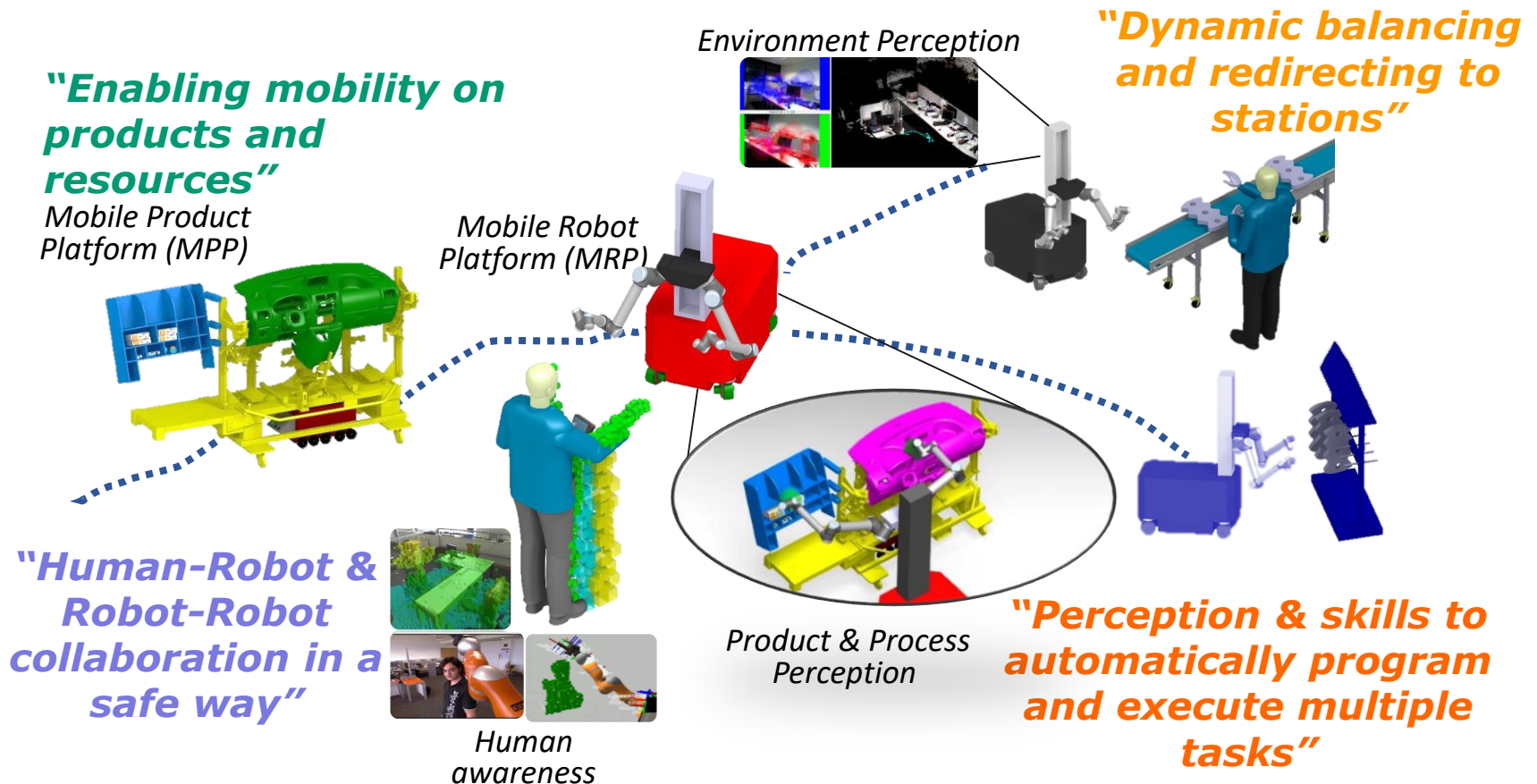
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LMS

*Laboratory for
Manufacturing Systems
& Automation*



Dynamic reconfigurable shopfloors

"Enabling mobility on products and resources"

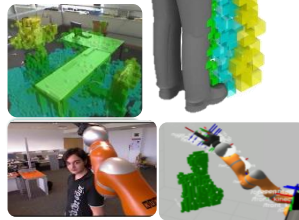
Mobile Product Platform (MPP)

Mobile Robot Platform (MRP)

Environment Perception

"Dynamic balancing and redirecting to stations"

"Human-Robot & Robot-Robot collaboration in a safe way"



Human awareness

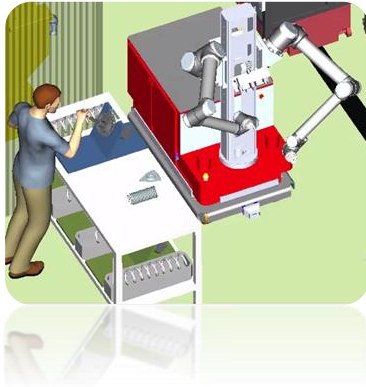
Product & Process Perception

"Perception & skills to automatically program and execute multiple tasks"

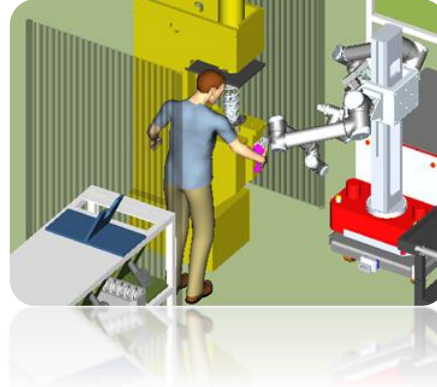
❑ Automotive pilot case

PSA
GROUPE

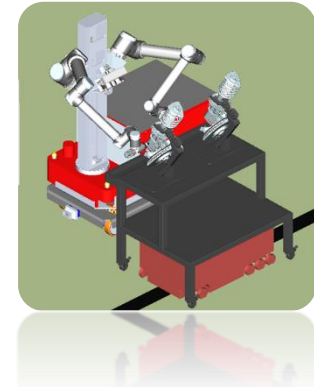
DAMPER PRE-ASSEMBLY



DAMPER COMPRESSION



DAMPER ASSEMBLY ON THE DISK



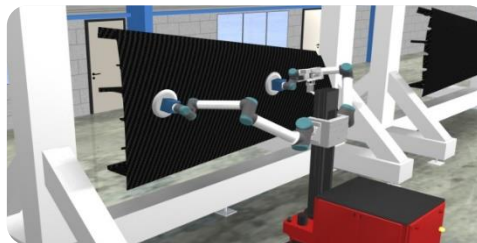
❑ Aeronautics pilot case

AERnnova

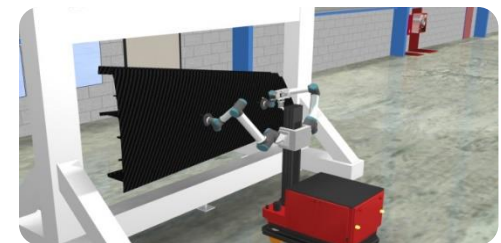
DRILLING



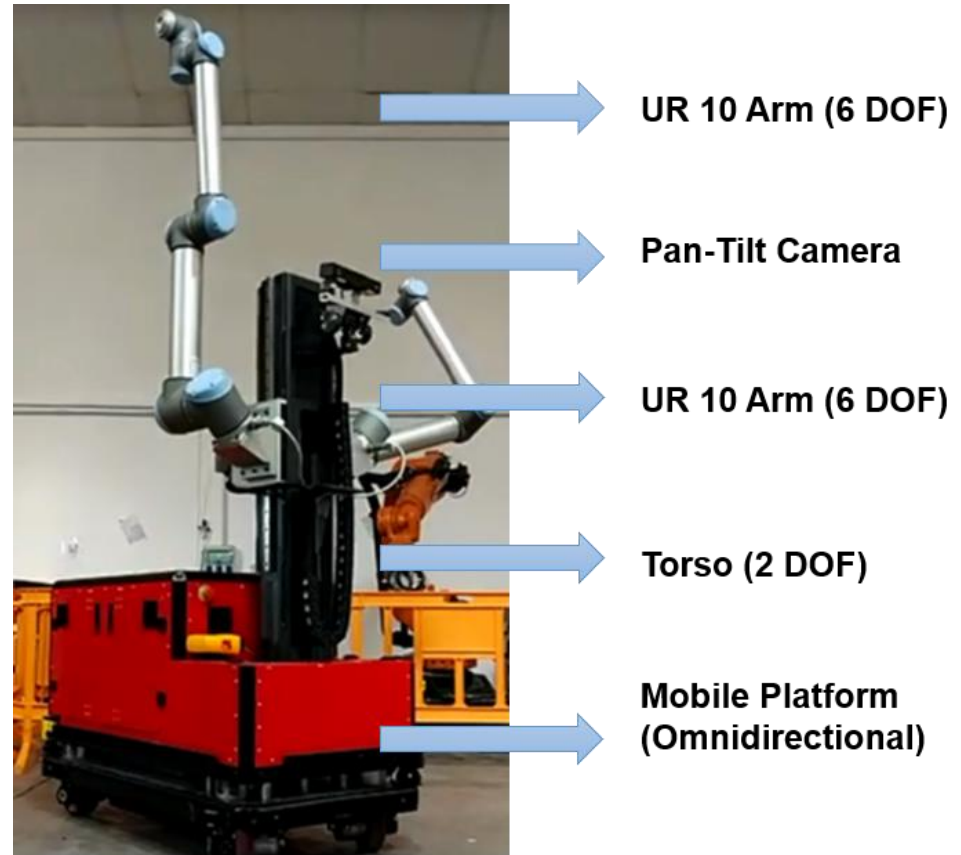
SURFACE PREPARATION



SURFACE PREPARATION

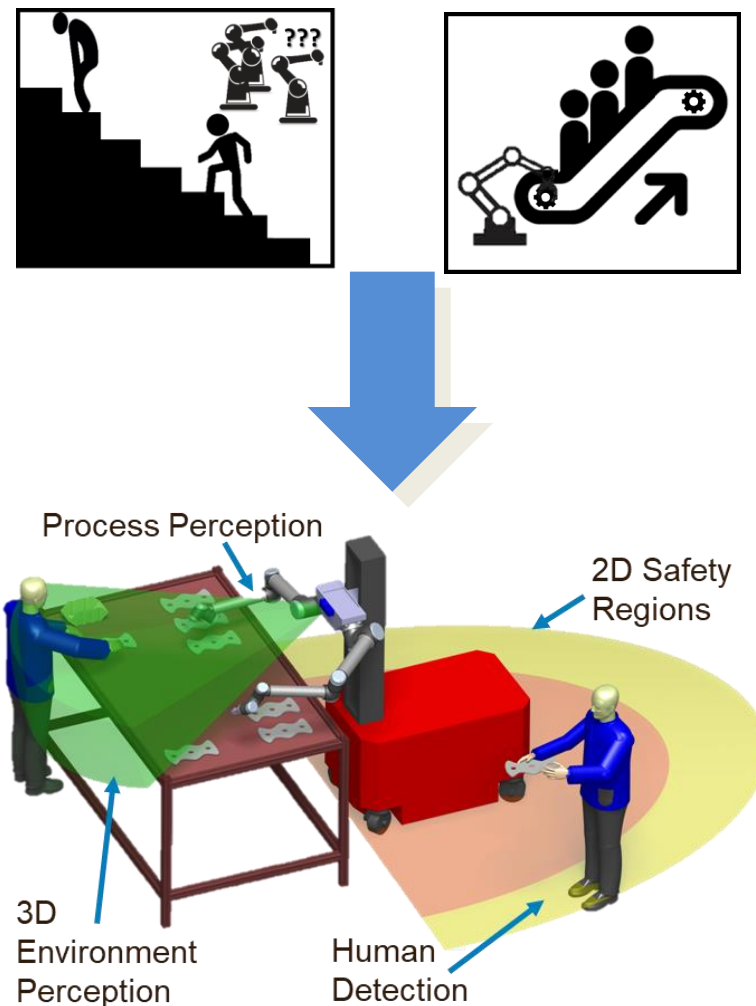


- ✓ **Autonomous navigation** across the shopfloor **in a safe way**
- ✓ **Perform a variety of tasks** using on-board tooling
- ✓ **Dual arm manipulation** enhancing dexterity
- ✓ Collaborate with humans **acting as assistant** to them
- ✓ Collaborate with **other mobile resources** through share perception



Mobile dual arm workers acting as assistants to humans are in the forefront of research agenda for industrial applications in EU manufacturing

- Existing challenges
 - Safety issues for removing fences
 - Accuracy in navigation / localization
 - Easy programming techniques
 - Intuitive interaction mechanisms
 - Monitoring and control of execution



Mobile dual arm workers acting as assistants

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These are low level - process execution related concerns ...



Monitoring and control of execution

Environment
Perception

Human
Detection

Mobile dual arm workers acting as assistants

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***BUT, to enable a full scale
assembly process execution ...***

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Monitoring and control of execution

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- E

BUT, to enable a full scale assembly process execution ...

... Methods for integrating and re-scheduling the work into the dynamic changing environment are needed



Monitoring and control of execution

Environment
Perception

Human
Detection

Mobile dual arm workers acting as assistants

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*Thus, in this topic the focus is on
HOW:*

- ✓ To model this dynamically changing environment
- ✓ To distribute the task to the available resources
- ✓ To enable adaptable robot behavior

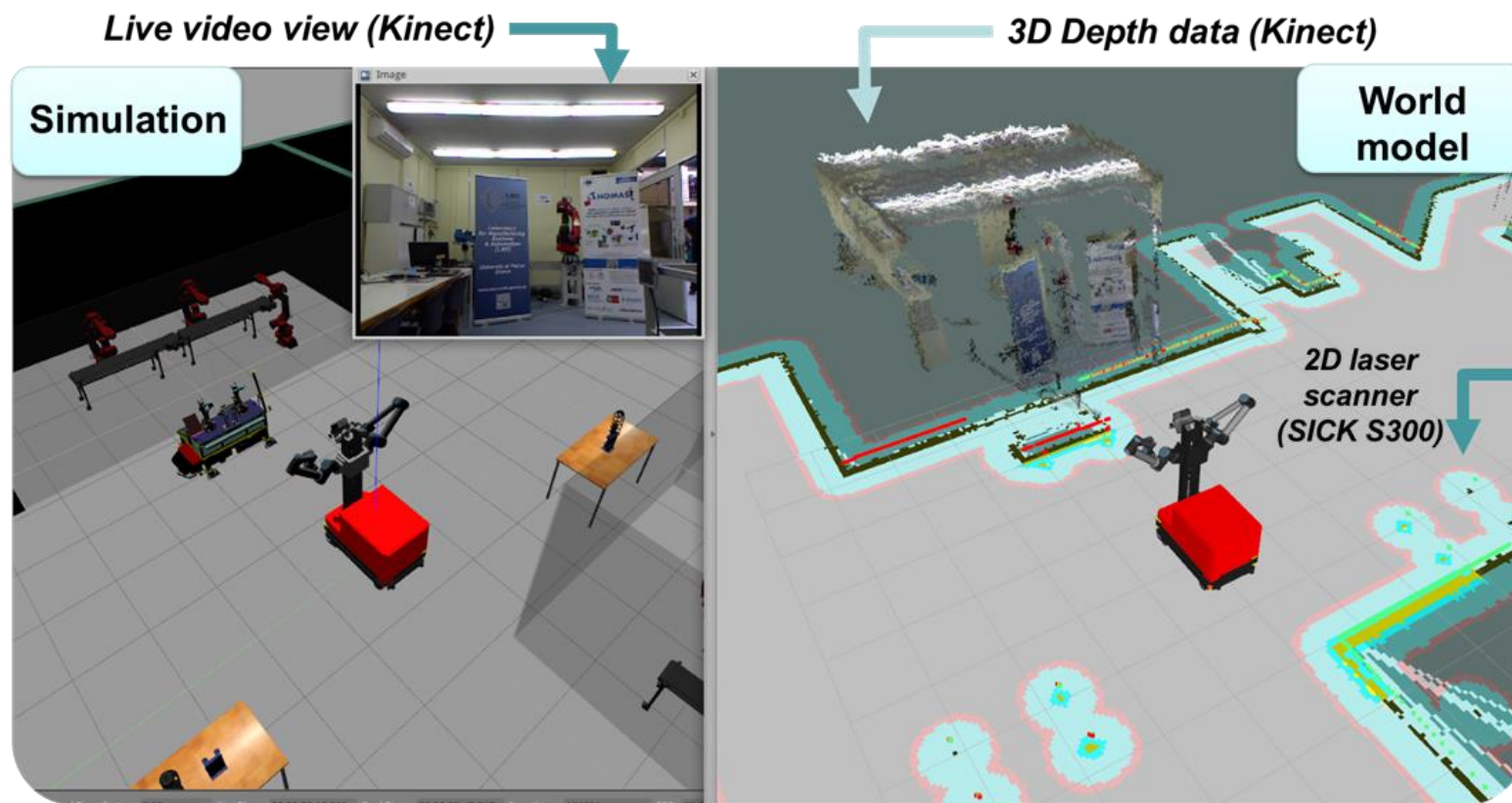


Monitoring and control of execution

Environment
Perception

Human
Detection

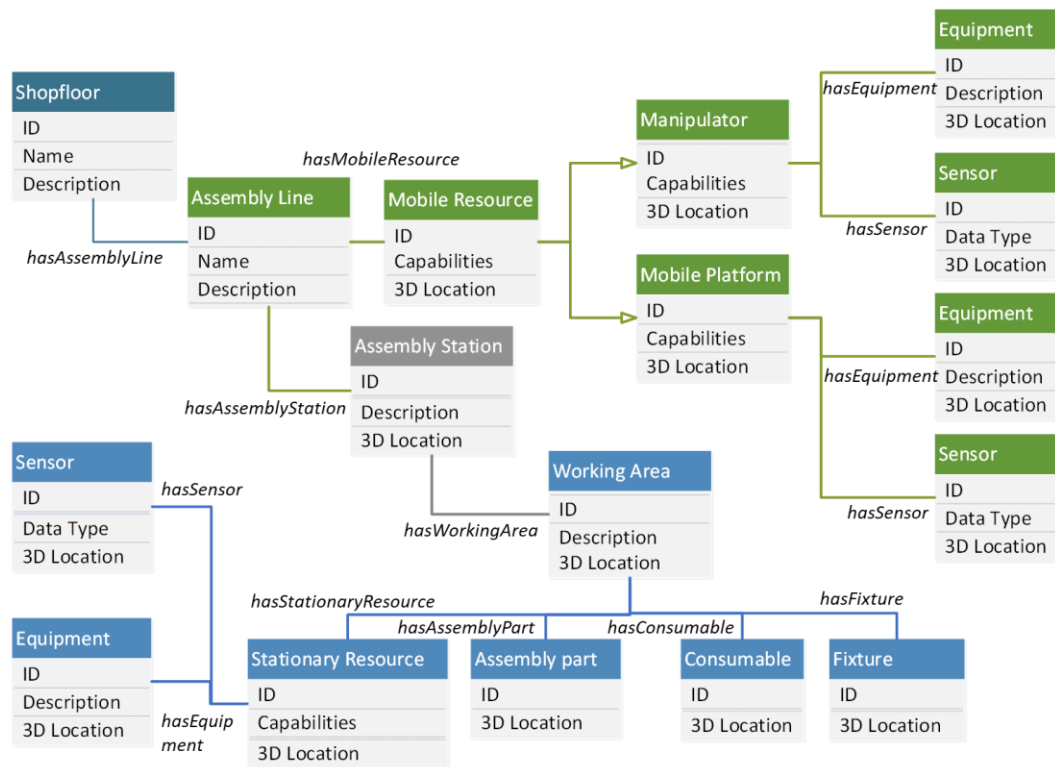
HOW to model this dynamically changing environment ?



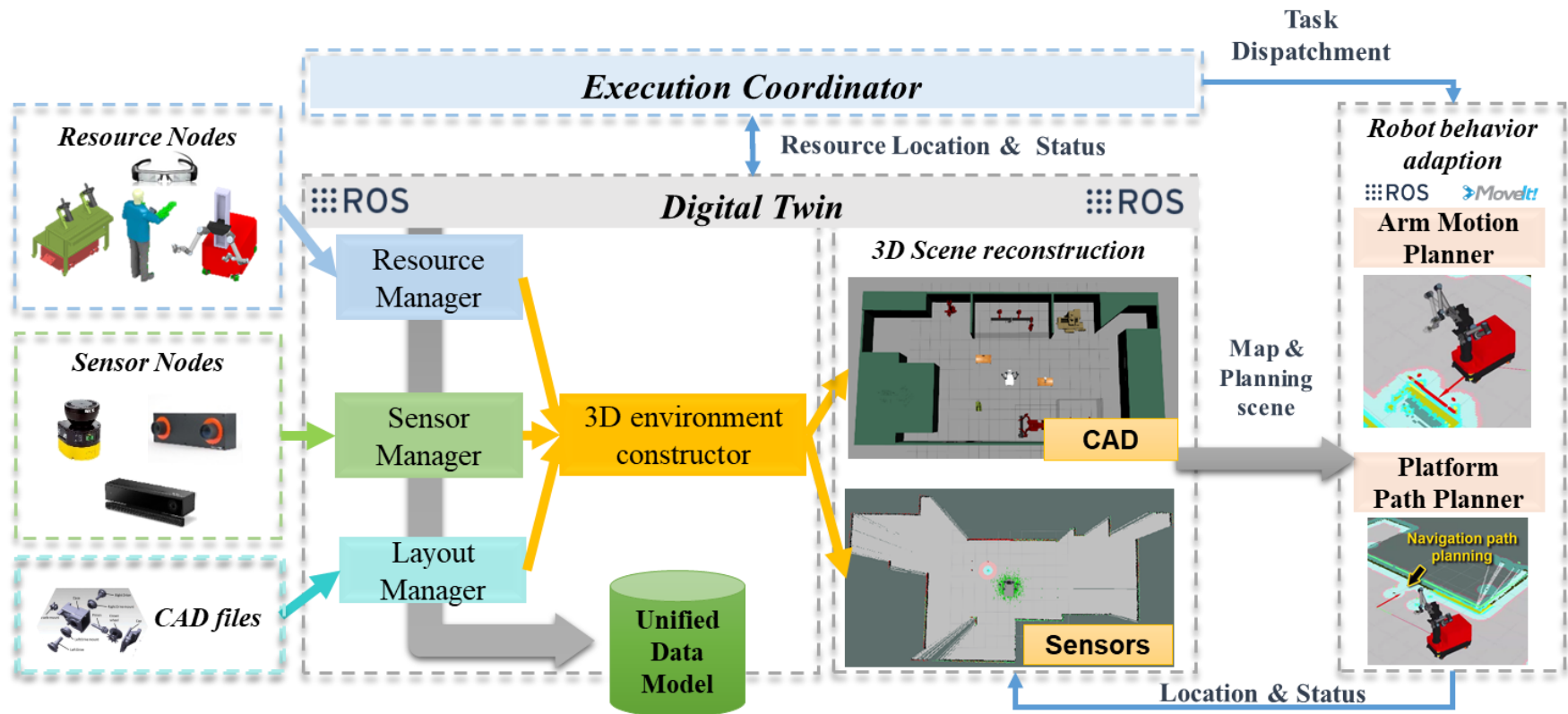
HOW to distribute the tasks to the available resources ?



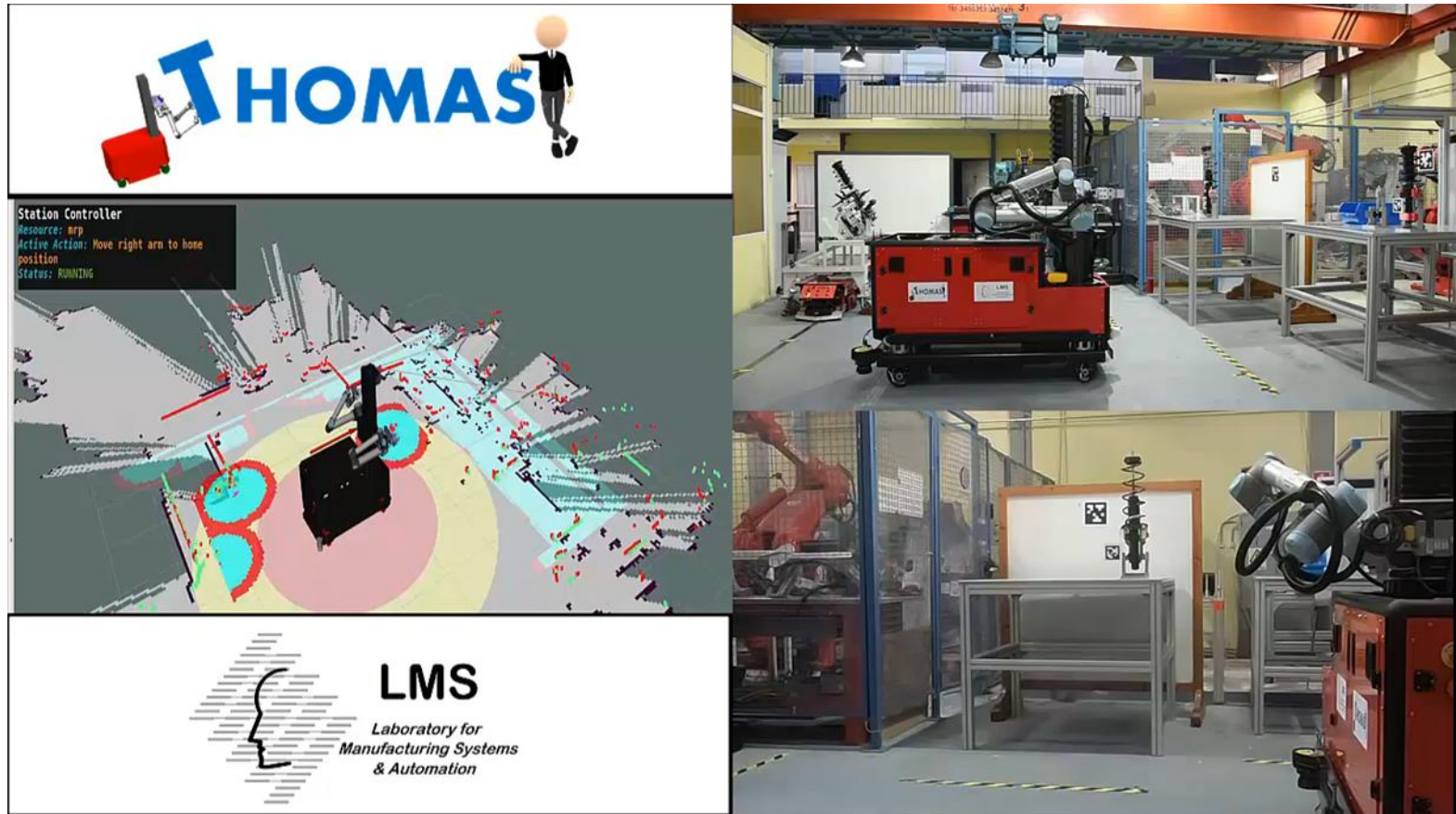
- ✓ **Hierarchical modelling** of the shopfloor / process
- ✓ **Resources suitability** assessment
- ✓ **Intelligent** – search based – **multi - criteria** decision making
- ✓ Digital world model based dynamic robot programming
- ✓ Alternative scenarios assessment based on **real time shopfloor data**



HOW to ensure adaptable robot behavior ?



Outcome and discussion



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Thank you for your Attention!

Questions?



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For more information visit us at www.thomas-project.eu