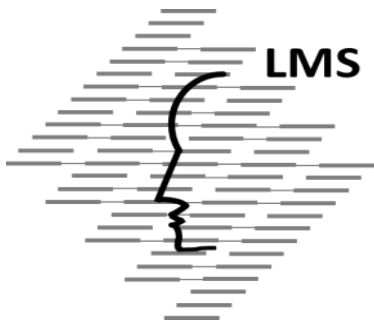




## **Integrating business, education & research: The KNOW-FACT Knowledge Alliance**

Dr. Dimitris Mavrikios



**Laboratory for Manufacturing Systems & Automation**

University of Patras

**<http://www.lms.mech.upatras.gr/>**

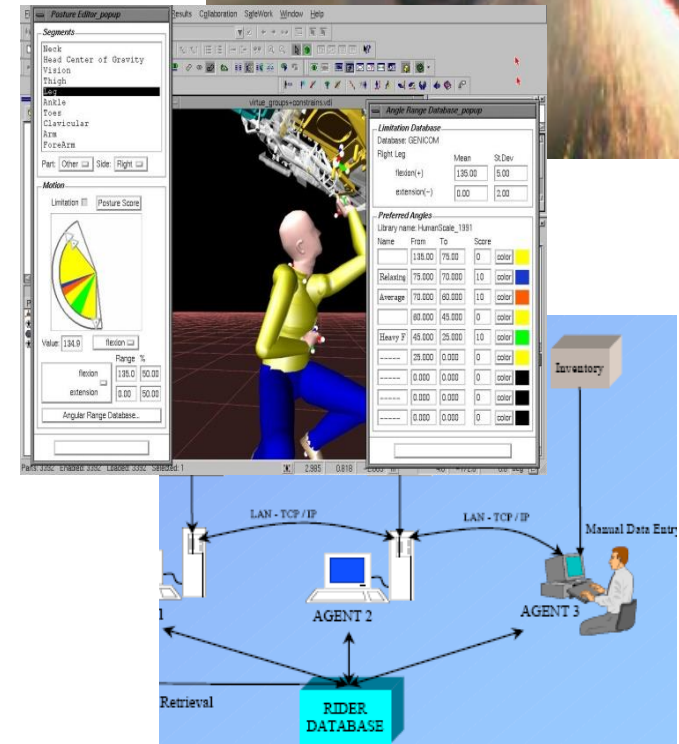
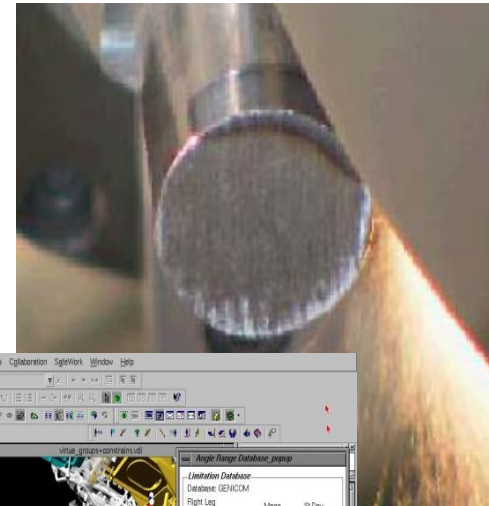
# Organization profile

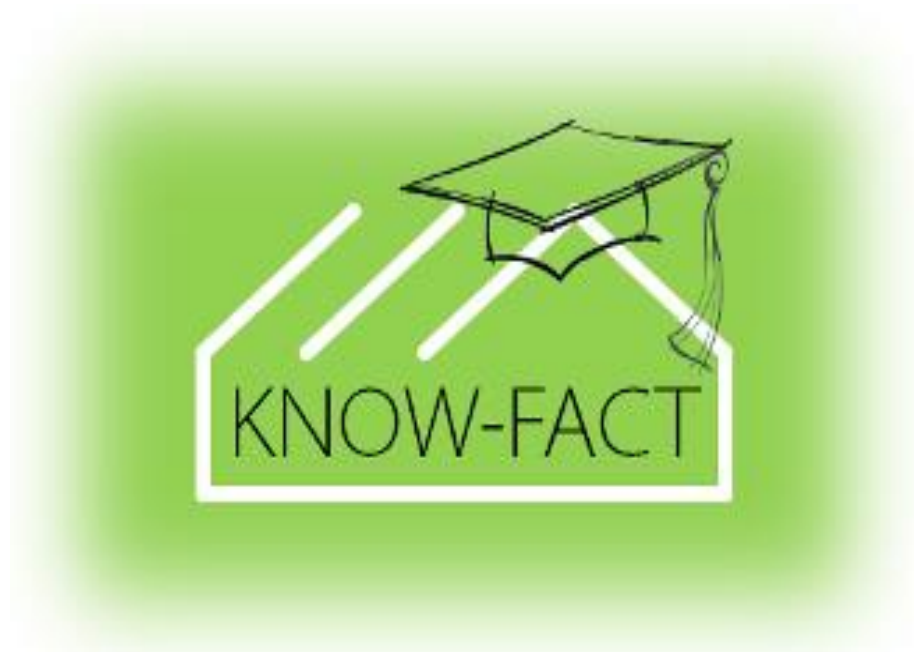
**LMS** is oriented on research and development in cutting edge scientific and technological fields.

LMS is involved in a number of research projects funded by the CEU and European industrial partners. Particular emphasis is given to the co-operation with the European industry as well as with a number of "hi-tech" firms.

LMS is organized in three different groups:

- 1.Manufacturing Processes Modelling and Energy Efficiency**
- 2.Robotics, Automation and Virtual Reality in Manufacturing**
- 3.Manufacturing Systems**





<http://www.knowfact-project.eu/>

**A Knowledge Partnership for the definition and launch  
of the European *Teaching Factory* paradigm  
in manufacturing education**

## Background

- ❑ Manufacturing is a subject that cannot be handled efficiently, only inside a classroom.
- ❑ The development of educational curricula has not kept pace with the growing complexity of industry, technology and economy.
- ❑ Research outcomes of educational institutions are typically presented to the scientific community without having been directly accessible to industry. Within this context, industry may not either comprehend or adapt to the technological advances in a direct way.

**Thus, the promotion of a novel approach to manufacturing education that would integrate education, research and innovation, emerges as a key challenge**

## Background



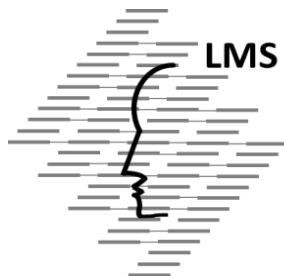
The concept of the **Teaching Factory** has its origins in the medical sciences discipline and specifically in the paradigm of the teaching hospitals.



Aiming to become a new paradigm in engineering education and training, the **Teaching Factory** initiative will have a hybrid mission:

- Industrial training and education for university students
- Take-up of research results and training for industry engineers & blue-collar workers

## Partnership



### **Project Coordinator**

Laboratory for Manufacturing Systems & Automation

Director: Prof. George Chryssolouris

University of Patras, Greece

**FESTO**



**POLITECNICO  
DI MILANO**



**TECHNISCHE  
UNIVERSITÄT  
DARMSTADT**

**tecnalia**

**CASP S.A.**

## Objective and outputs

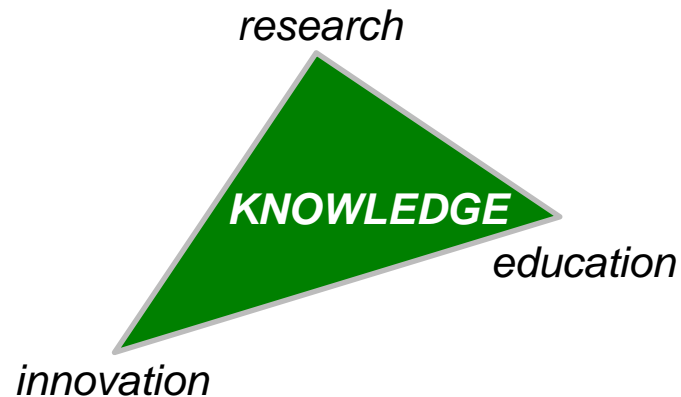
The KNOW-FACT **objective** has been to launch a University-Business cooperation to elaborate and validate the emerging concept of the Teaching Factory at a European level and identify its exploitation potential.

KNOW-FACT has delivered:

- A complete study for the conceptualization and implementation of the Teaching Factory initiative, including the
  - concept definition
  - layout and technological infrastructure specification
  - learning content definition
- Pilot runs for the validation of the underlying concepts and the delivery mechanisms
- An Extended Partnership of associated academic and industrial organizations to support follow-up and future implementation activities



# Approach



**The Teaching Factory**  
as a 2-ways  
“learning channel”  
communicating



... industrial practices to the classroom

... “new” knowledge to the factory



# Approach

## “Factory to Classroom”



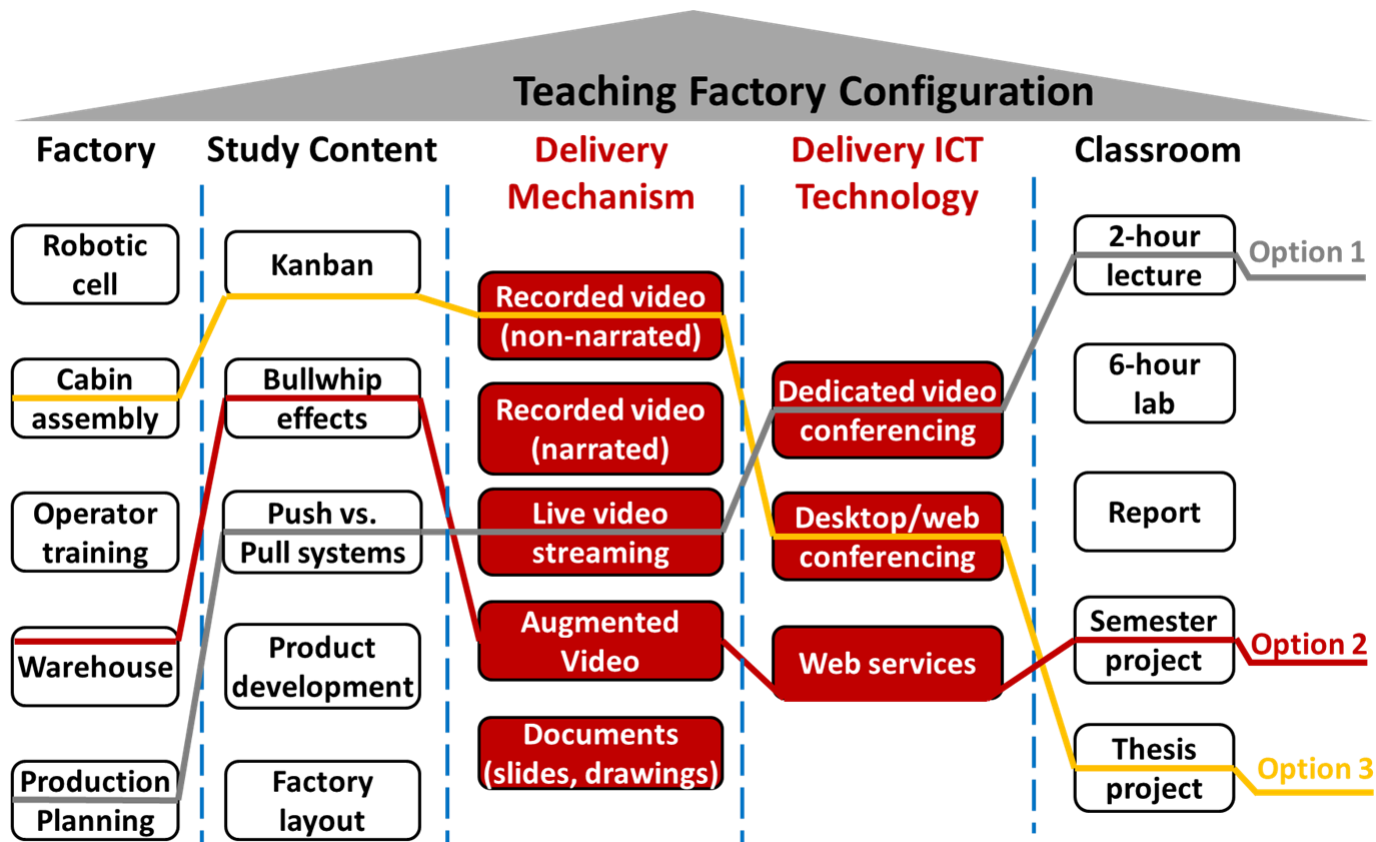
- **Students** in the classroom act as the **knowledge “receivers”**
- On the industry side, **engineers introduce and present real shop floor problems**
- **Student projects** are launched on the basis of the shop-floor problems

## “Lab to factory”



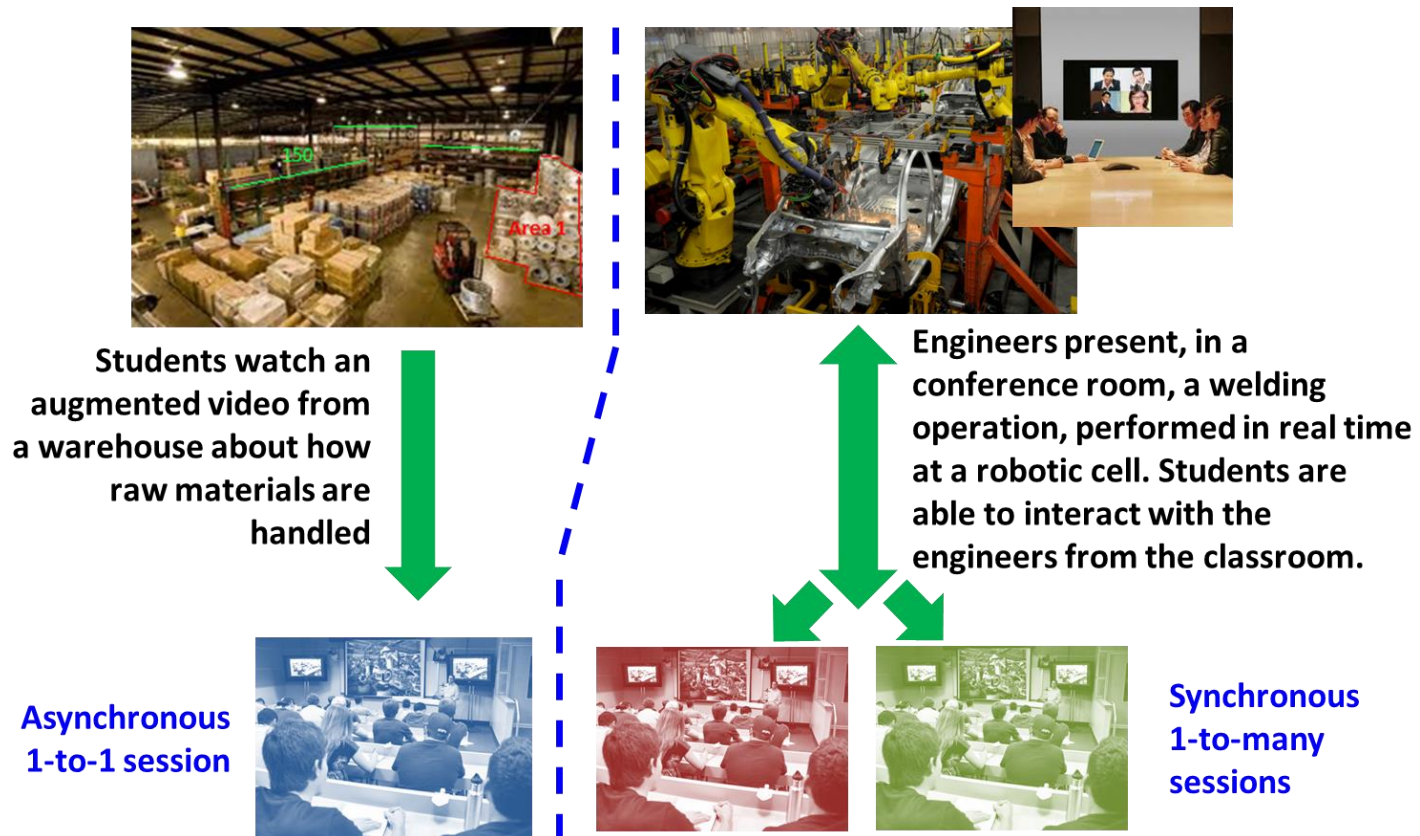
- **Engineers** at an industrial site act as the **knowledge “receivers”**
- Academic facilities provide the **test-bed** for presenting and demonstrating **research results**.
- New **solutions to industrial problems** are investigated on the basis of these results.

# Approach



Modular configuration of the factory-to-classroom knowledge communication

# Approach



Multiple layouts of the factory-to-classroom knowledge communication channel

# Pilot project 1

Industry

*knowledge transfer* →

Academia



**Industrial problem:**

- **line balancing of a new production area**
- **planning of material kitting area**

**4 Volvo engineers**

**20 LMS students**

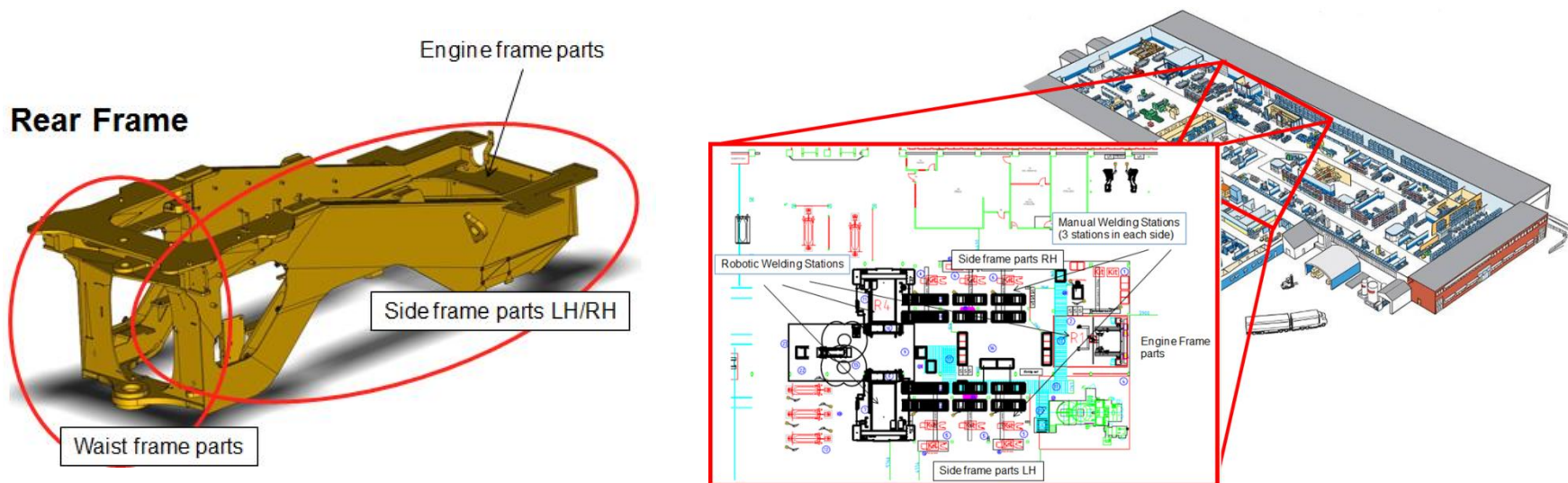
**6 weeks (2h session per week)**



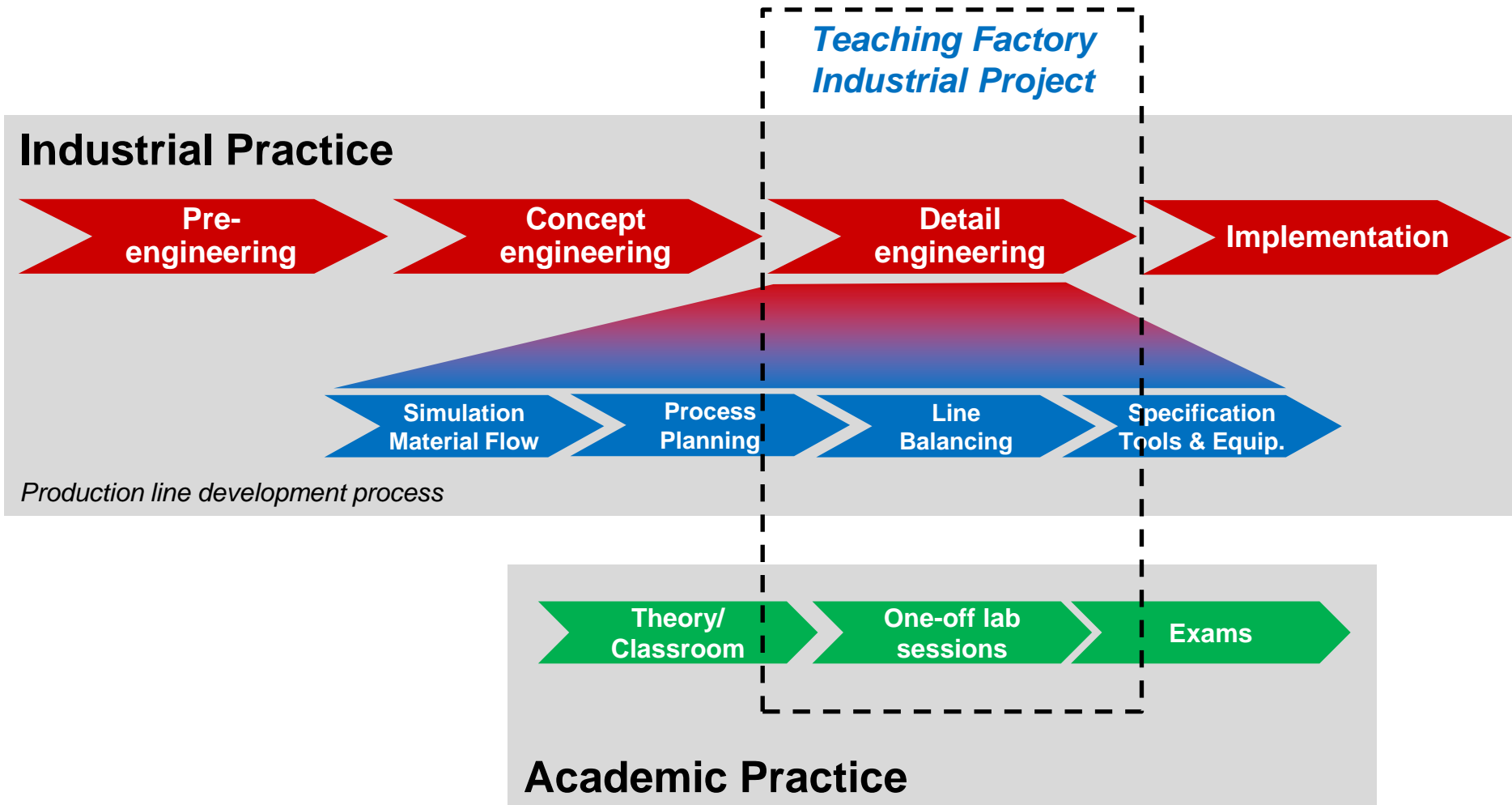


## Pilot project 1

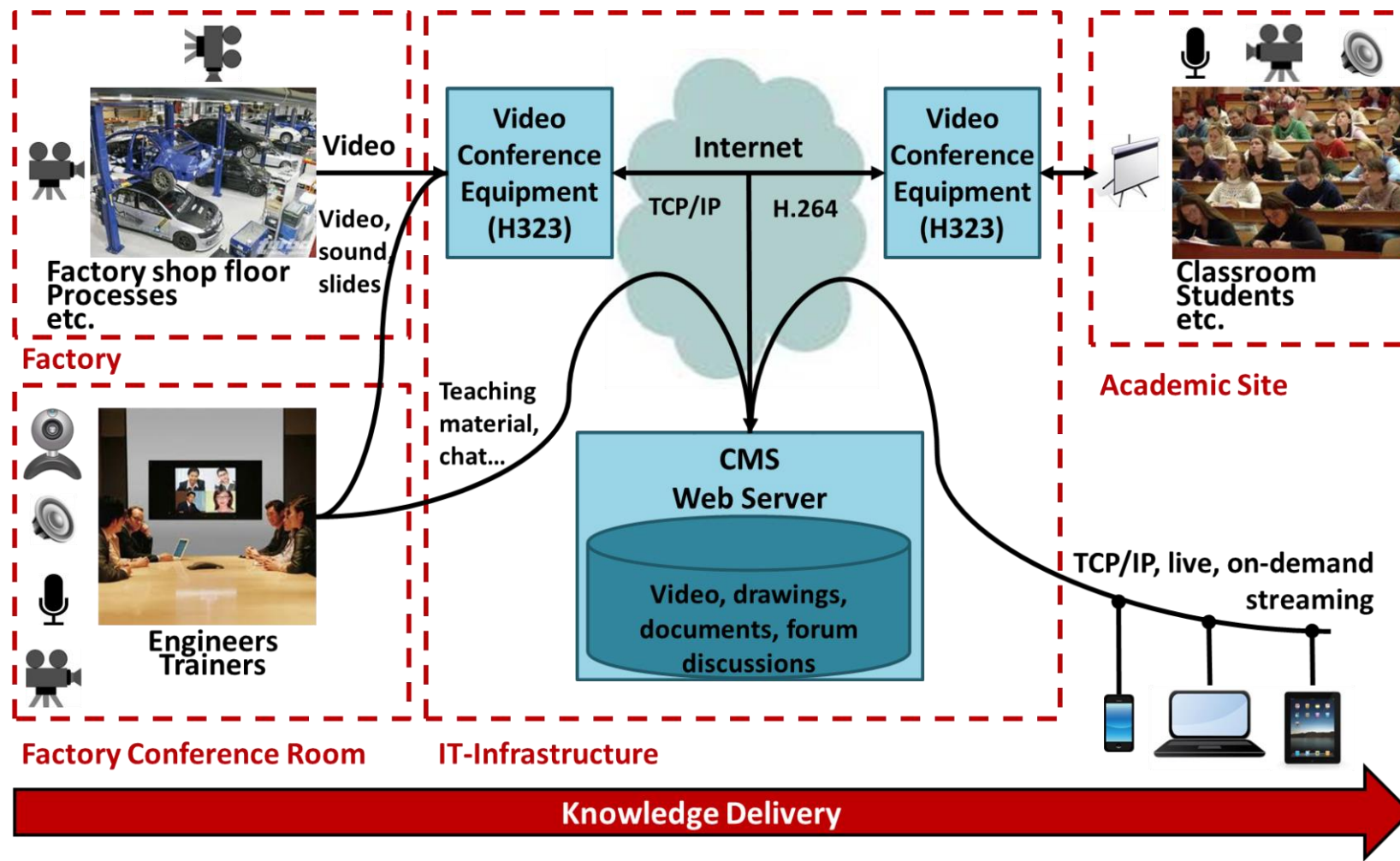
- Volvo Construction Equipment
- Material flow simulation project
- Use of DES (discrete event simulation) software to address the problem



# Pilot project 1



# Pilot project 1





# Pilot project 1

## ICT Infrastructure



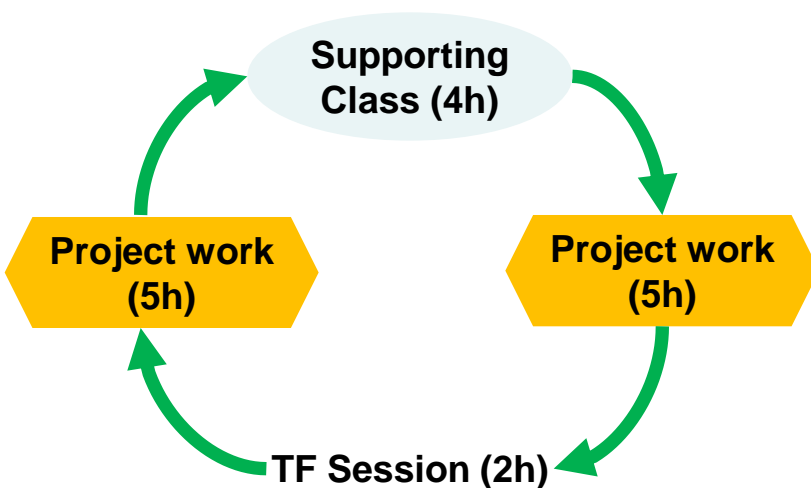
Academia - Students

Industrial Partner

## Pilot project 1

### Implementation plan

#### Weekly cycle



13.11.12	<i>Introduction to VCE production and problem definition</i>
20.11.12	<i>Discussion on problem</i>
27.11.12	<i>Initial theoretical approach</i>
04.12.12	<i>Evaluation of model design and approach</i>
11.12.12	<i>First draft results</i>
18.12.12	<i>Solution presentation</i>
15.01.13	<i>Follow-up on solution and discussion</i>

## Pilot project 2

Industry

knowledge transfer

Academia

**FESTO**



**Industrial problem:**

- **new integration and control architecture for industrial robots**

**5 FESTO engineers**

**7 LMS research engineers**

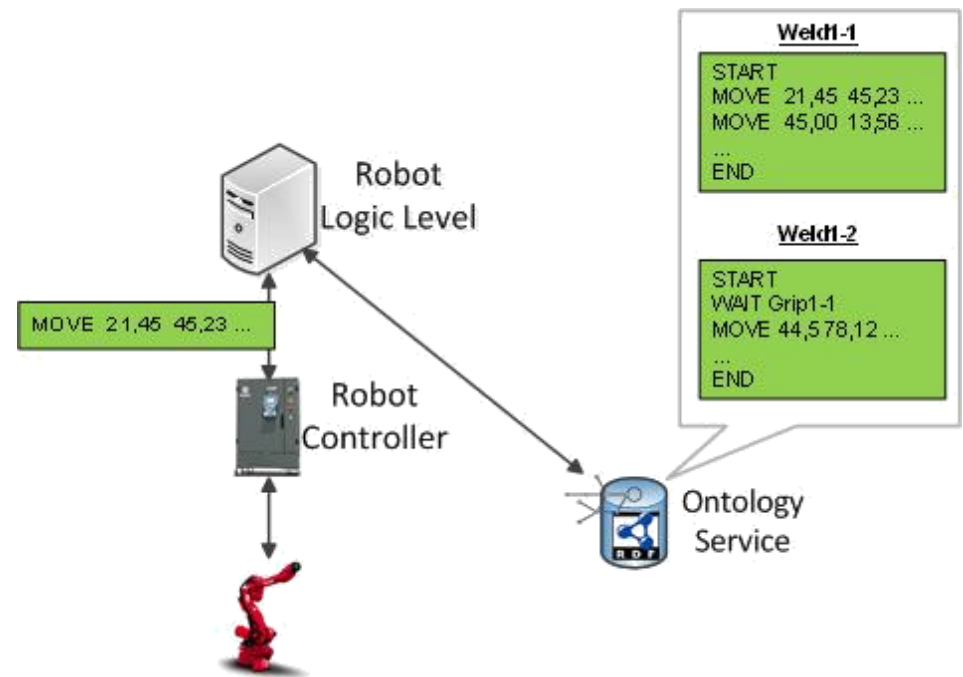
**3 weeks (1h session per week)**



## Pilot project 2

### Unit Level: Local Autonomous Decision Making

- Local coordination
- Monitoring operations
- Main tasks:
  - Automated robot program generation, retrieval and execution
  - Gripper exchange coordination



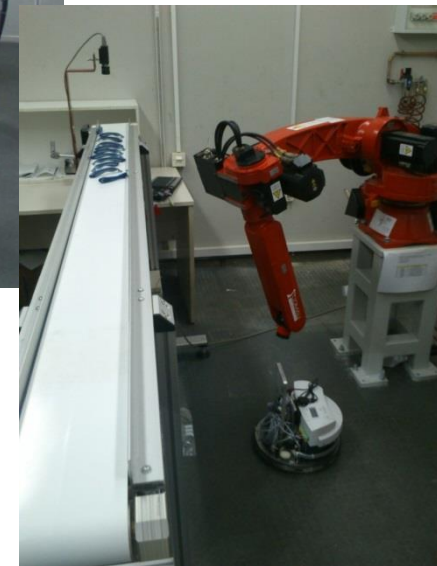


## Pilot project 2

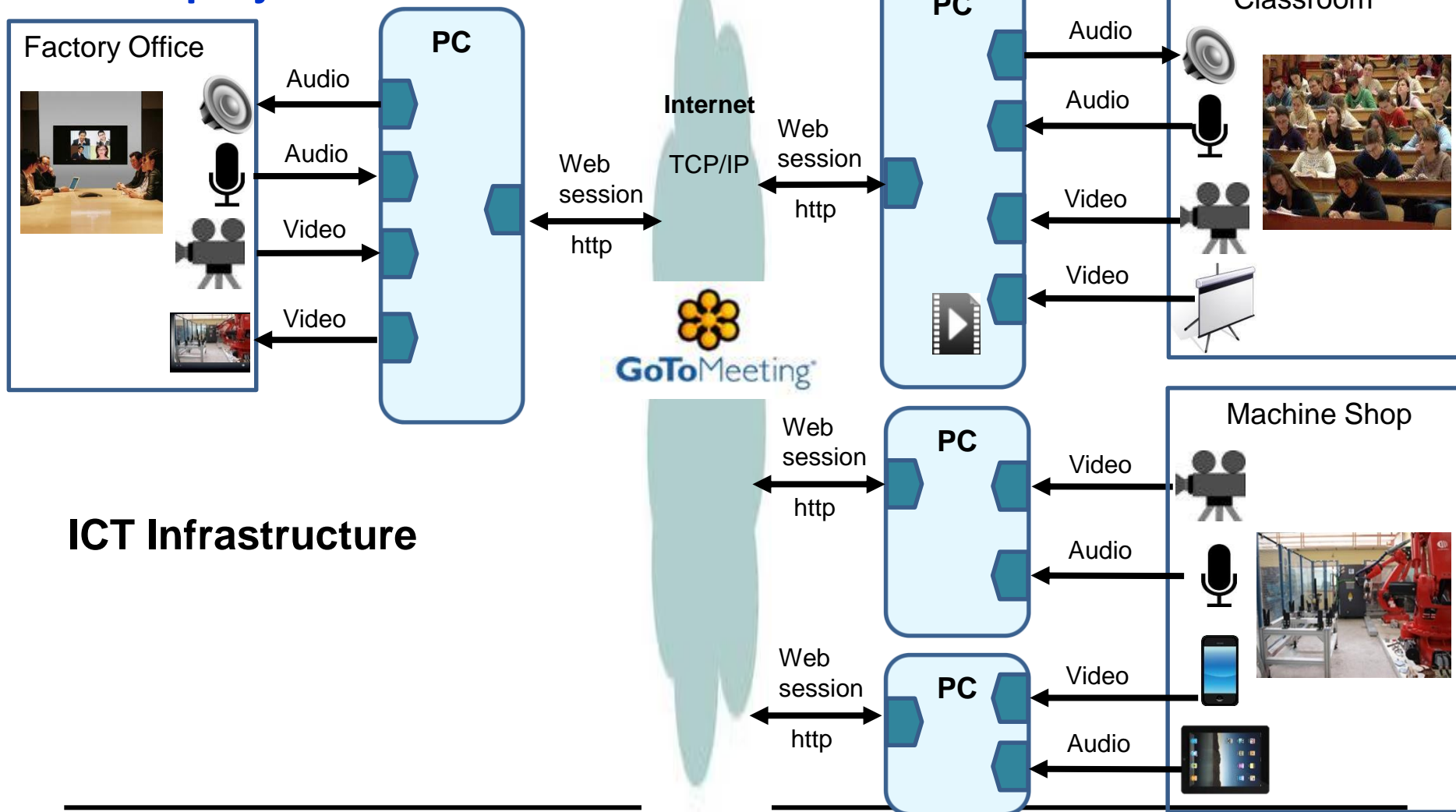
### Demonstrator 1: Car underbody welding



### Demonstrator 2: Plastic Razor handling

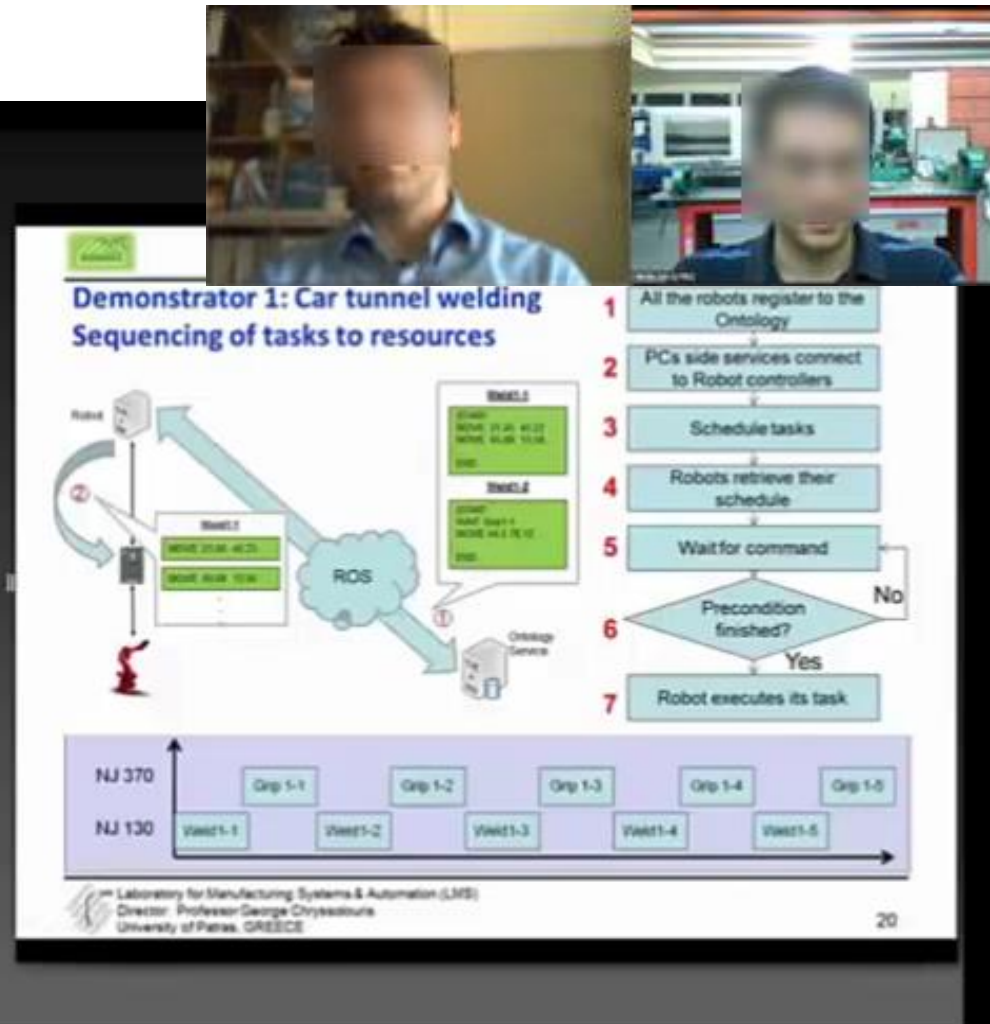


## Pilot project 2



## ICT Infrastructure

## Pilot project 2





# Results

## Teaching Factory added value for Academia:

- **New experience** for both the students and the faculty
- New kind of teaching that is **not available in theoretical lectures**, or one-time labs
- Gives the ability for the **students to deepen their knowledge** in certain topics and apply that in practice, while addressing real-life problems, and working in view of actual deadlines and industrial practice terms
- At the end their work will have a **real impact** outside the academic environment
- Bring in **direct touch, researchers/students with industry**
- Better **industrial orientation in the academic research**
- Facilitate the production innovation by offering new ways of thinking and demonstrating **new solutions to companies** (e.g. SMEs)

## Results

### Teaching Factory added value for Industry:

- Provided ideas and **solutions that would not have been considered** during the standard company processes of solving such problems
- Opportunity to give a wider range of solution proposals, which consequently resulted in **better decision support**
- The engineers had the chance to interact from the factory with a pool of students that had a **problem solving capacity, with real talent and out-of-the-box thinking**
- A new form of **outsourcing** which benefits both the factory (**in terms of resources**) and the academia (**in terms of access to real industrial needs**)
- **Didactic content/approach** is critical

## Follow-up actions

### Maintain & extend cooperation with the project partners

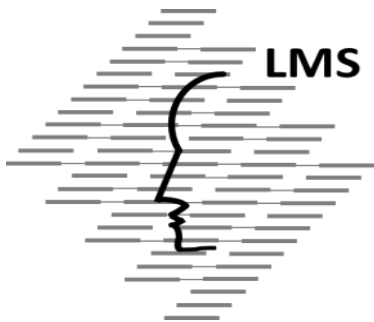
- Following the end of the project, partners have been working together on the **exploitation** of the project outputs
- In several occasions, they also built-up **bigger teams / groups** in order to work on specific activities requiring a critical mass of actors
- Activities have aimed to enrich the background concepts of the Teaching Factory paradigm and **extend the application scale** at a network level
- Project outputs have been also applied and validated through **additional use cases**, demonstrating the wide applicability of the developed paradigm
- On the basis of these activities, the Teaching Factory has gained Europe-wide recognition as a **promising new paradigm** for manufacturing education

# Thank you for your attention!

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Dr. Dimitris Mavrikios ([mavrik@lms.mech.upatras.gr](mailto:mavrik@lms.mech.upatras.gr))

Dr. Loukas Rentzos ([rentzos@lms.mech.upatras.gr](mailto:rentzos@lms.mech.upatras.gr))



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