



Learning factories in partner institutions

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MIGUEL ALTUNA LHII



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Agenda

- Collaborative learning factory
- Learning Factories (in order of appearance)



- **CMQ** (France)



- **SANTURTZI LHII** (Basque Country)



- **ARMERIA LHII** (Basque Country)



- **GETKİM VET** (Türkiye)



- **DHBW** (Germany)



- **MADE** (Italy)



- **TOLOSALDEA LHII** (Basque Country)



- **CAMOSUN** (Canada)

LCAMP Collaborative Learning Factory



What is a Learning Factory?

“a close-to-reality factory environment for education, training, and research purposes, which enables experiential learning in a realistic industrial setting.” (Abele et al., 2017)

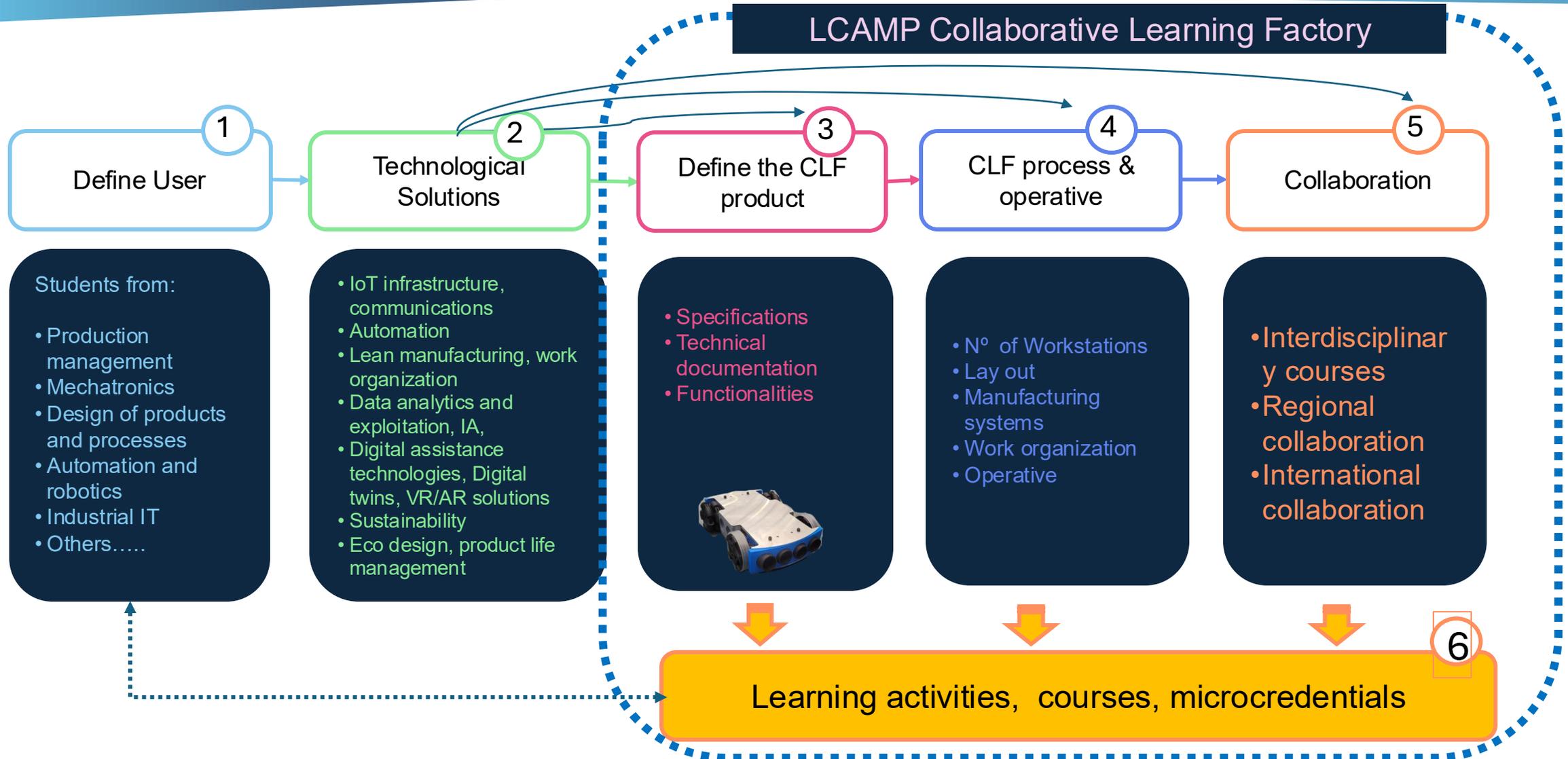
What is the LCAMP Collaborative Learning Factory?

Physical environment with learning purposes that recreate the entire value chain to produce a product with the closest similarity to reality and **with specific features to enhance collaboration.**

General features of the LCAMP collaborative learning factory

- A semi-industrial learning environment
- Allows integration of I4.0 technologies and infrastructures in education facilities
- Multiple disciplines co-work in the same LF
- Enables the collaboration between geographically separated VET centres

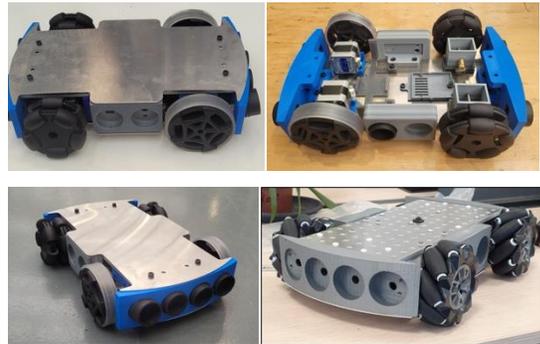
LCAMP Collaborative Learning factory



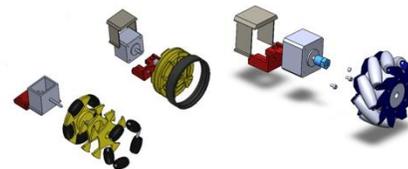
LCAMP – Collaborative Learning Factory

LCAMP Collaborative Learning Factory

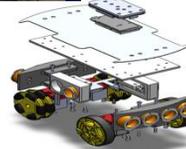
LCAMP product



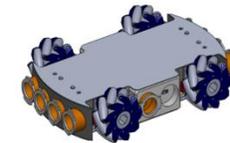
01 work-station Wheels assembly



02 work-station Chassis assembly



03 work-station Final assembly



IoT infrastructure-MES – Digital twin

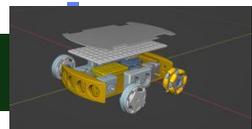
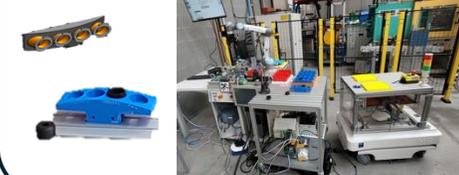
Work-Station Machining



Work-station 3D printing

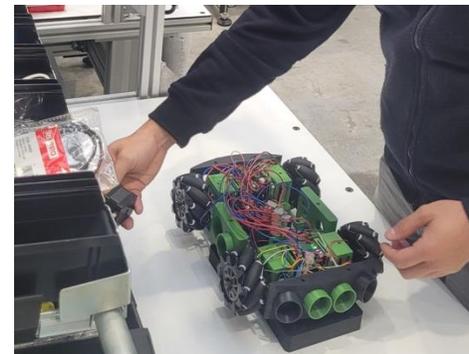


Work-stations Sensor assembly



Morphology of the LCAMP CLF

https://lcamp.eu/wp-content/uploads/sites/53/2024/12/D6-1_Part-2-Morphology-of-the-CLF-v-1.0.pdf



Example of Collaborative Learning Factory implementation at Miguel Altuna LHI's facilities (Basque Country)

Assembly cell

Examples of Learning factories in partner institutions

 <p>CAMPUS DES MÉTIERS ET DES QUALIFICATIONS D'EXCELLENCE Industrie du futur Occitanie</p>	 <p>LYCÉE <i>la Découverte</i> DECAZEVILLE</p>	● CMQ	(France)
 <p>LHFP SANTURTZI</p>		● SANTURTZI LHII	(Basque Country)
 <p>ArmeriaEskola^x</p>		● ARMERIA LHII	(Basque Country)
 <p>GEBKIM EDUKITZ, ARABAZTOKIA ETA SAHASKUN VAKO! 2017</p>		● GETKIM VET	(Türkiye)

 <p>DHBW Duale Hochschule Baden-Württemberg Heidenheim</p>	● DHBW	(Germany)
 <p>MADE Competence Center I4.0</p>	● MADE	(Italy)
 <p>Tolosaldea Lanbide Heziketa Institutua</p>	● TOLOSALDEA LHII	(Basque Country)
 <p>CAMOSUN COLLEGE</p>	● CAMOSUN	(Canada)



CAMPUS
DES MÉTIERS
ET DES
QUALIFICATIONS
D'EXCELLENCE

Industrie du futur
Occitanie

LYCÉE
la Découverte
DECAZEVILLE

COLLABORATIVE LEARNING FACTORY

LÉONARD Camille
European project officer

BELMON Christophe
Teacher

WWW.CMQINDUSTRIEDUFUTUR.COM

WWW.DECOUCVERTE.MON-ENT-OCCITANIE.FR



CMQE If's CLF

WHO WE ARE



**CAMPUS
DES MÉTIERS
ET DES
QUALIFICATIONS
D'EXCELLENCE**

Industrie du futur
Occitanie

CMQE If

The CMQE If is a training cluster aimed at developing and promoting vocational training in the Industry 4.0 sector.

Promote industry careers and training

Build successful pathways for all

Support professional entry

Develop international openness.



LYCÉE
la Découverte
DECAZEVILLE

LA DÉCOUVERTE

La Découverte high school offers **general**, **technological**, and **vocational** programs ranging from EQF levels 3 to 5.

For industrial vocational training, the following fields are covered:
mechanical production, industrial boiler making, Europlastic, plastic and composite , and sciences industrielles de l'ingénieur

CMQE If's CLF

OUR CLF



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ET DES
QUALIFICATIONS
D'EXCELLENCE
Industrie du futur
Occitanie



Our Collaborative Learning Factory is an immersive training space for our students, combining numerous manufacturing processes and Industry 4.0 technologies.

WHERE

LA DECOUVERTE HIGH SCHOOL
In Decazeville (Occitanie
Region)

WHO

STI2D students (Science and
Technology of Industry and
Sustainable Development) EQF 4
And more !

WHEN

Starts in September 2025

HOW

Multidisciplinary teaching
team (EQF levels 3-4-5)



CMQE If's CLF

WHAT WE DO



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ET DES
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Occitanie

LYCÉE
la Découverte
DECAZEVILLE

PARTS



All parts of the robot are produced in-house, except for the electronic components

PROCESSES



- CNC milling (3, 4, 5 axis)
- CNC turning (2, 3 axis)
- Wire EDM
- Sinker EDM
- 3D printing
- Laser cutting

TECHNOLOGIES



- Arkite
- Arduino communication
- Multi-signals
- Later : Kanban + Lean

MATERIALS

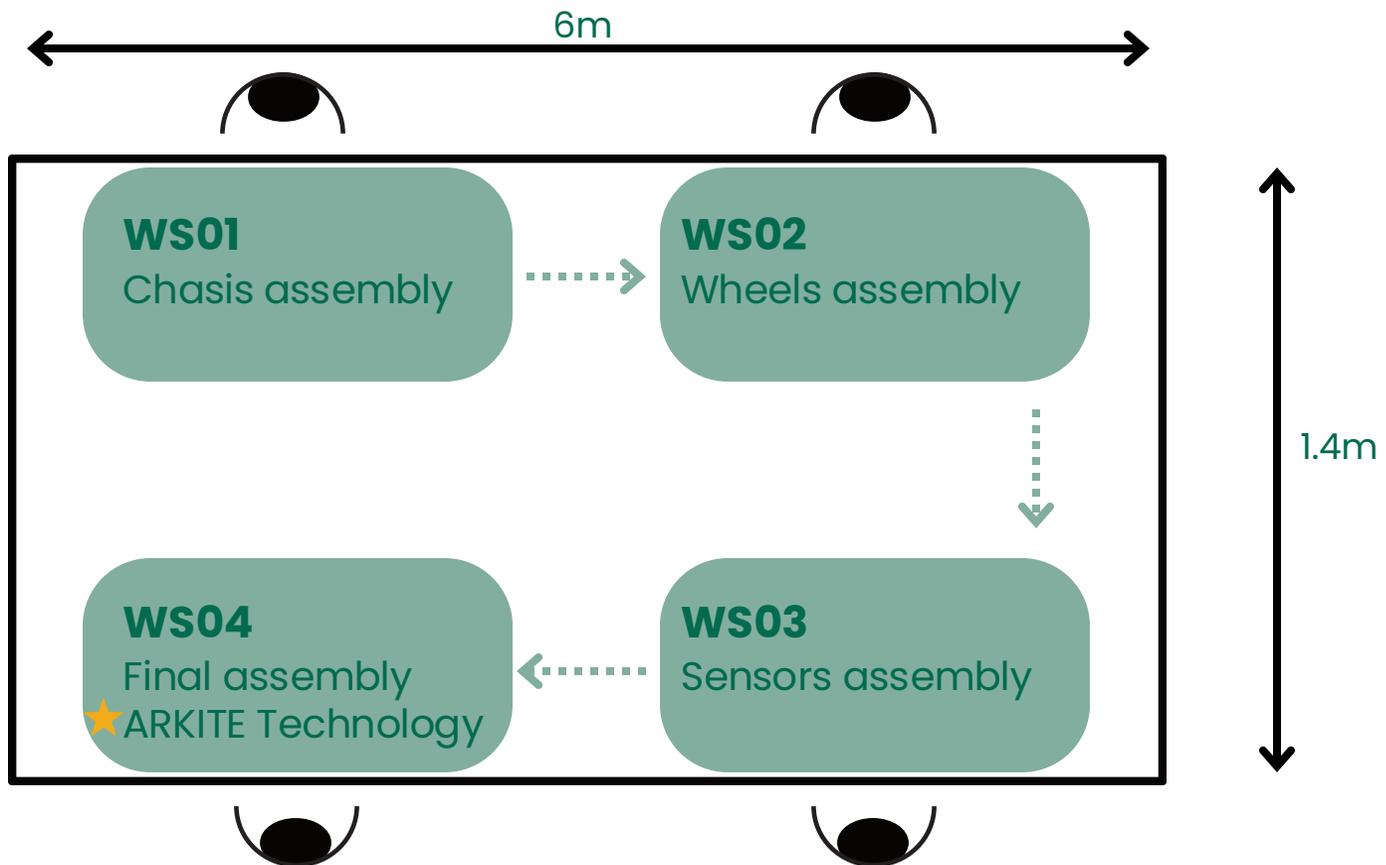


- Steel & Alloy steel (low & high)
- Aluminum alloy
- Copper
- Graphite
- Plywood
- Plastic material (PE, PP)

CMQE If's CLF LAYOUT



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ET DES
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WS05
3D Printing lab

WS06
Machining lab



Our Collaborative Learning Factory with 4 workstations for the assembly



Final assembly workstation with ARKITE system



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Industrie du futur
Occitanie

LYCÉE
la Découverte
DECAZEVILLE

CAMP
Teacher Centric Advanced Manufacturing Platform

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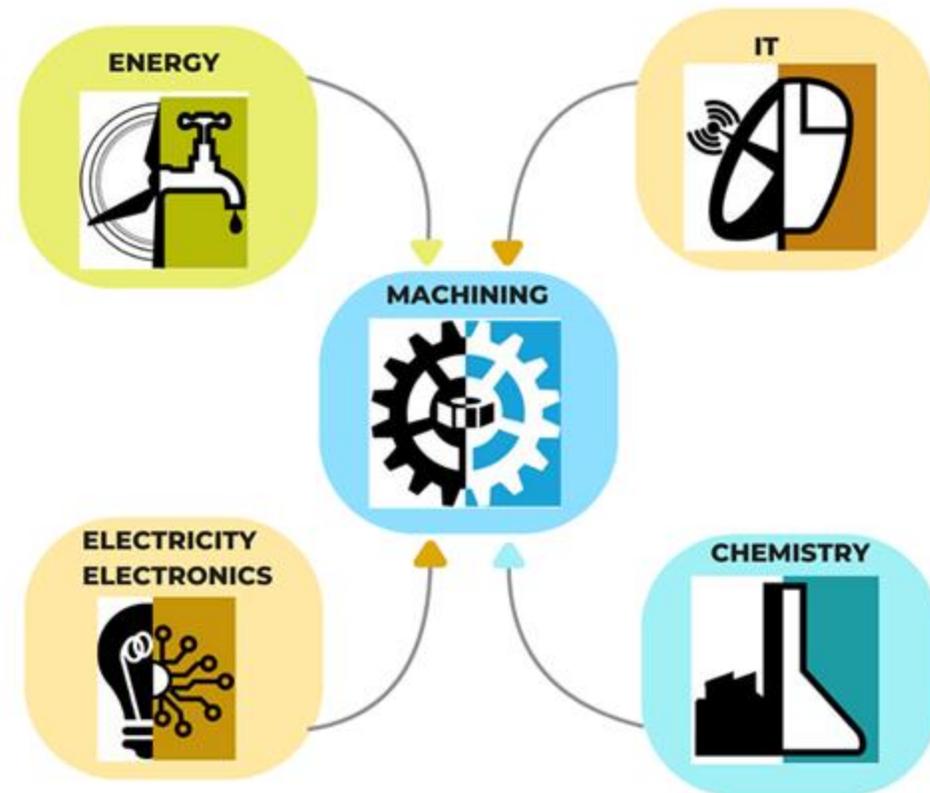


2025-05-13
LHFP
SANTURTZI



A Strategic Innovation for Our Center, 4 main goals

- Creating interdisciplinary collaboration



- **Real-world** industrial learning environment with students.
- Working with **projects** (ETHAZI)
- **Integrating cutting-edge technologies**
 - IA-BIG DATA
 - Green Hydrogen Energy Generation
 - 5G instalations

Learning Factory and IT: Key Areas of Implementation



- **Machine Usage and Control Management System:** control access, monitor machines (status real-time data), and ensure safe operation (checklist)
- **Maintenance Management Application:** preventive and corrective maintenance.
- **Intelligent Assistant:** providing students real-time technical information guidance,
- **IIoT Platform for Machine Monitoring:** collect and analyze real-time machine data for better decision-making.

Green Hydrogen Generation to Power 5G Radio Telecommunication Equipment



TELKI:

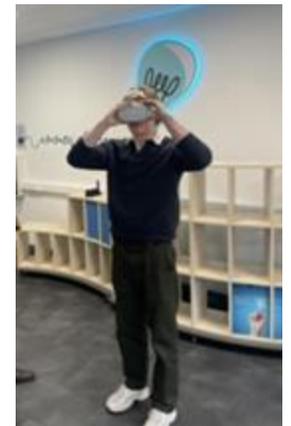
- Small-scale green hydrogen generation **laboratory**
- Designed as an **educational tool**
- Demonstration of electricity production using **green hydrogen**.

Two key approaches:

- **Collaboration with local entrepreneur**
 - Innovative patented communications broadcasting center
 - Access to advanced devices and equipment
- **Installation virtualization:** creating connection and disconnection exercises for other schools



5G Equipment



ESKERRIK ASKO!

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Alejandra Martinez Santos

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ARMERIA LEARNING FACTORY

LCAMP conference 2025

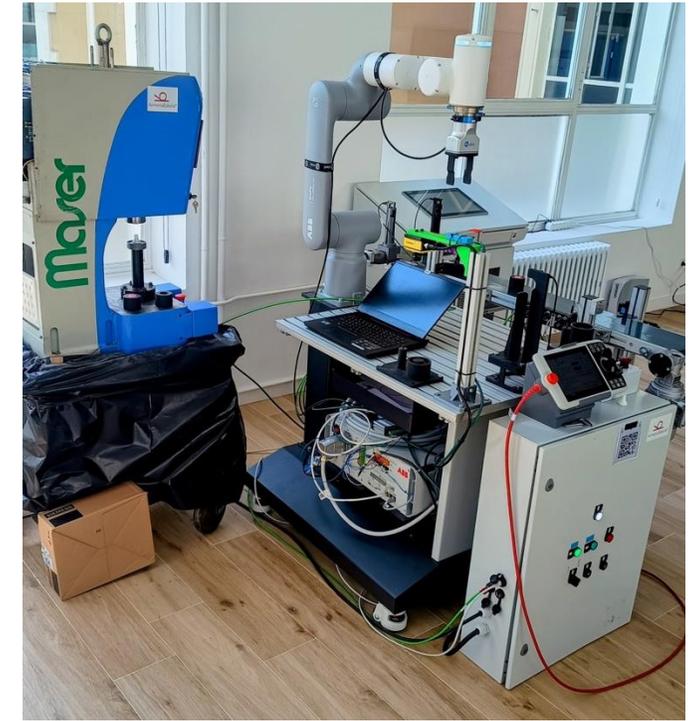
Finspang (SE)



ArmeriaEskola^x

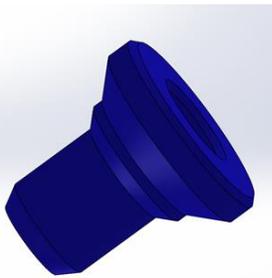
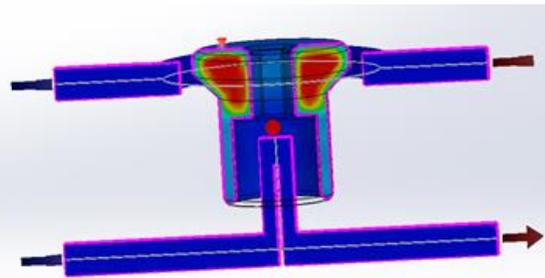
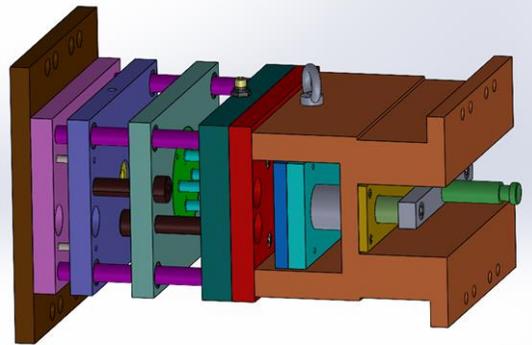
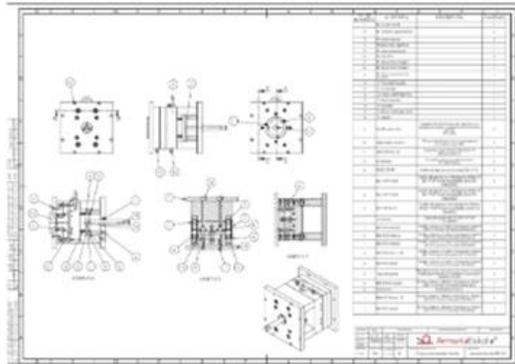
The Learning Factory is structured into two areas

- Component production area
- Automated assembly line

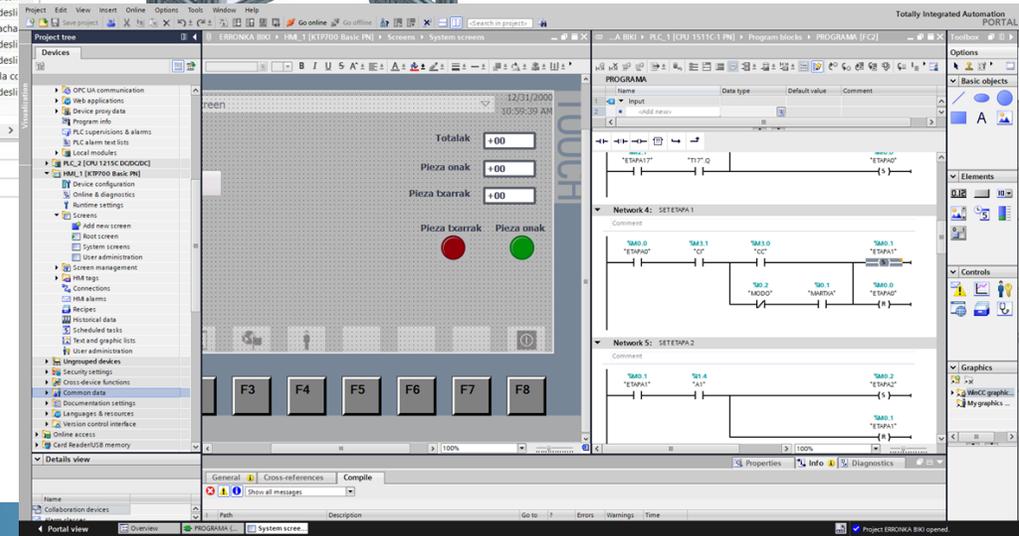
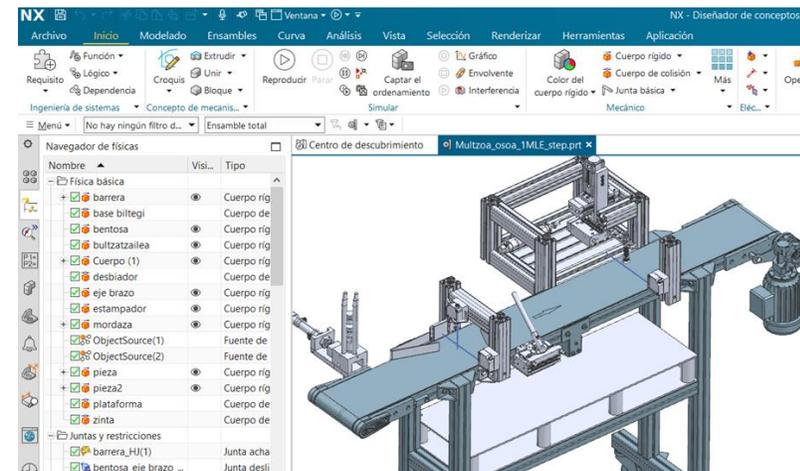


Study programs and main topics covered (2025)

- Design (EQF5)

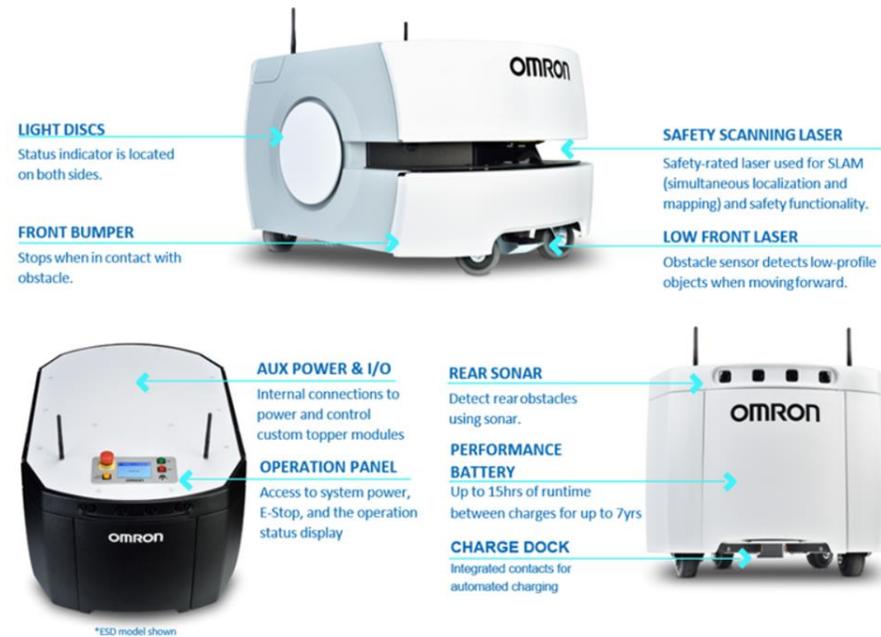


- Mechatronics (EQF 5)



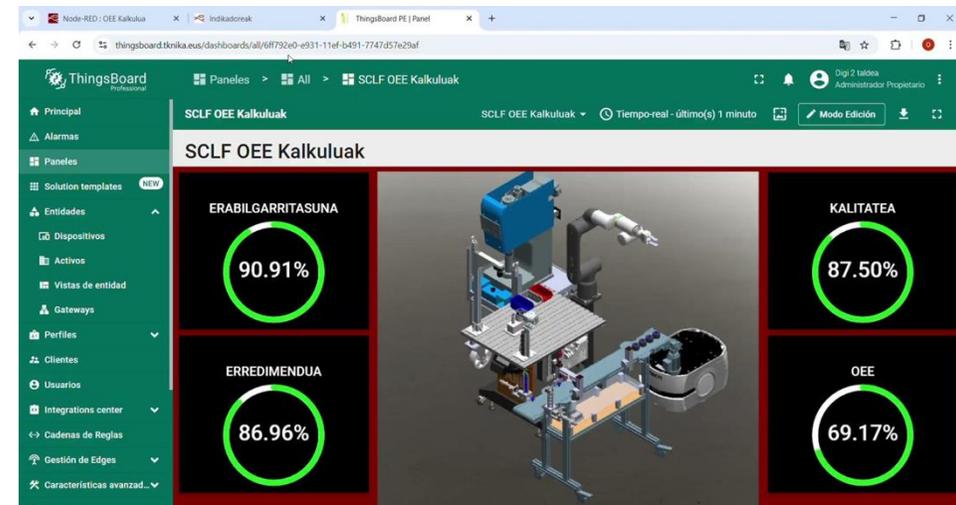
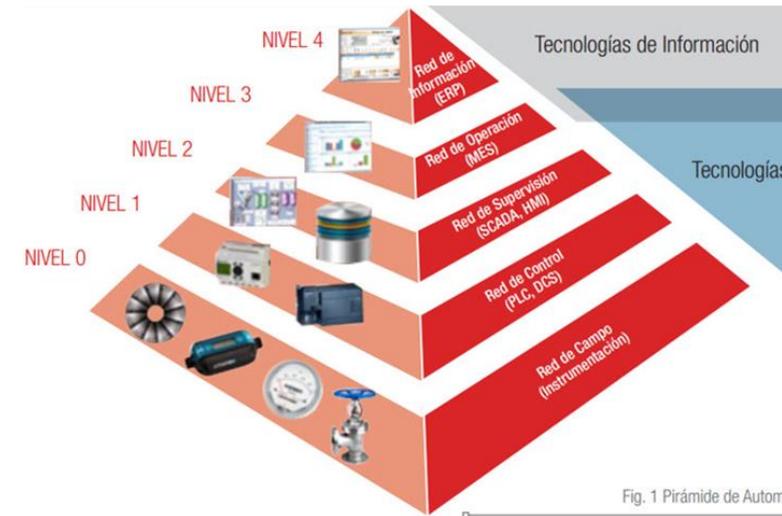
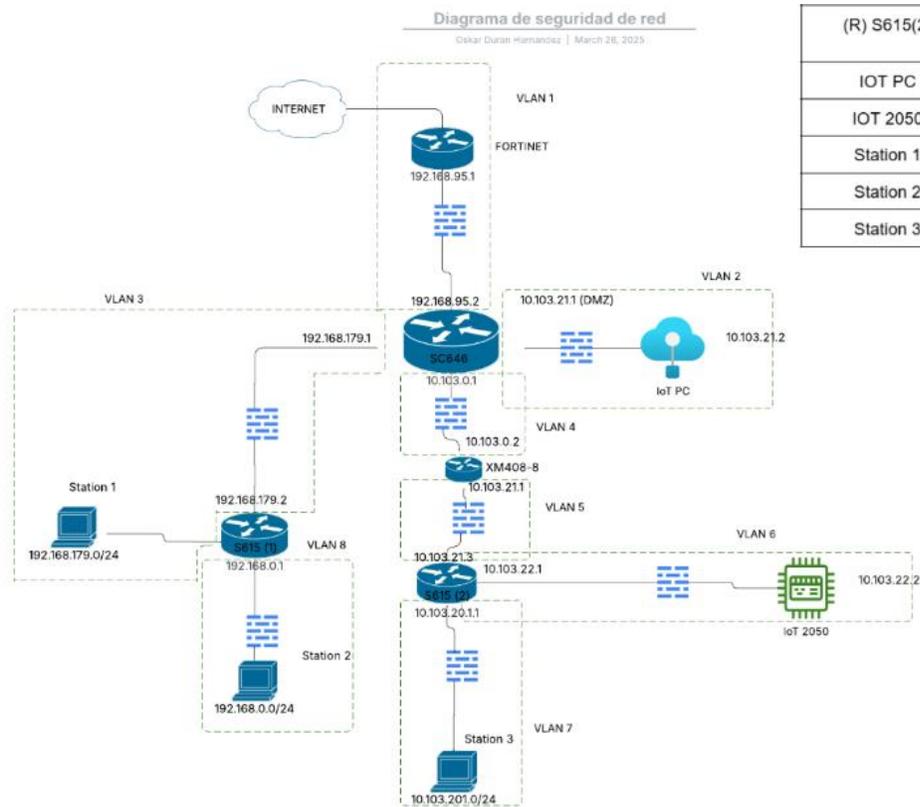
Study programs and main topics covered (2025)

- Robotics (EQF5)



Study programs and main topics covered (2025)

- Industrial digitalization (EQF5)



Study programs and main topics covered (2026)

- Machining (EQF5)



- Metrology (EQF5)



Future objectives and collaboration opportunities

- Evolve from a didactic to a real product
- Add a key technologie by study program and academic year
- 1 week learning mobilities of small student groups (± 6 students)

Study programme (EQF5)	Topics
Design	Plastic injection molding, punching and die cutting, tool and mold design, simulation and virtual validation
Machining	CAM, CNC milling, turning, EDM, grinding
Metrology	In-process metrology, coordinate measuring machine (CMM), contact profilometer, structured light scanning
Mechatronics	Digital twin, smart sensors (IO-link), safety
Robotics	Industrial and collaborative robotics, machine vision, bin-picking, machine tending, machine vision, motion control, AMR
Industrial digitalization	Industrial communications, condition monitoring, KPI dashboards, MES/ERP, blockchaine

ESKERRIK ASKO

<https://armeriaeskola.eus/en/>

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ArmeriaEskola^x



Collaborative Learning Factory in GEBKİM VET

Metehan GÜLLÜ
Abdullah GÖÇER

Introduction

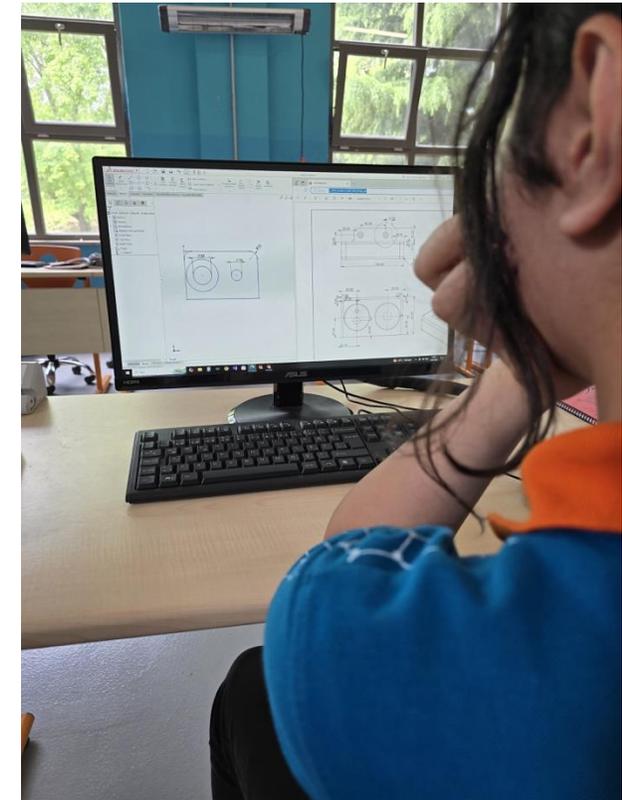
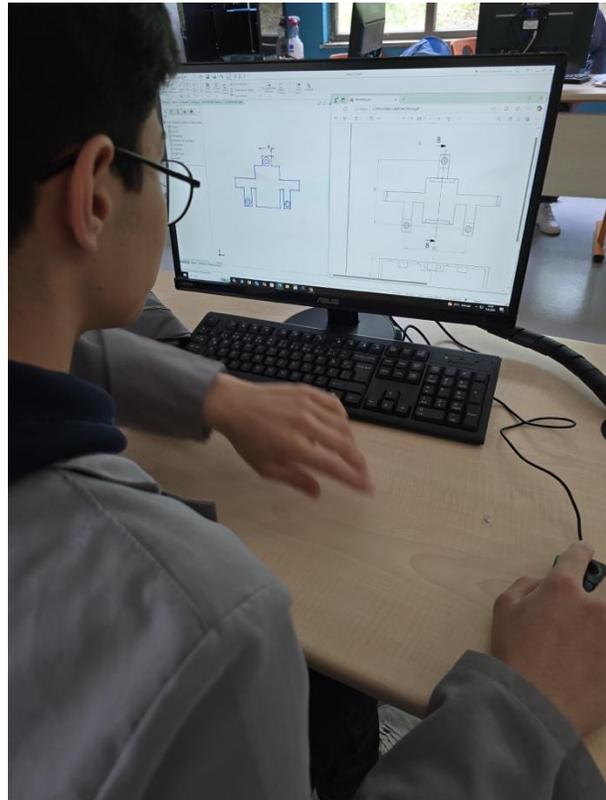


- Collaborative Learning Factory (CLF) studies carried out in our institute within the scope of LCAMP Project WP6 are carried out under the following headings;
- 1-) 3D Designing Studies
- 2-) 3D Printing Studies
- 3-) Manual Assembly Implementations
- 4-) Courses for CLF

3D Designing



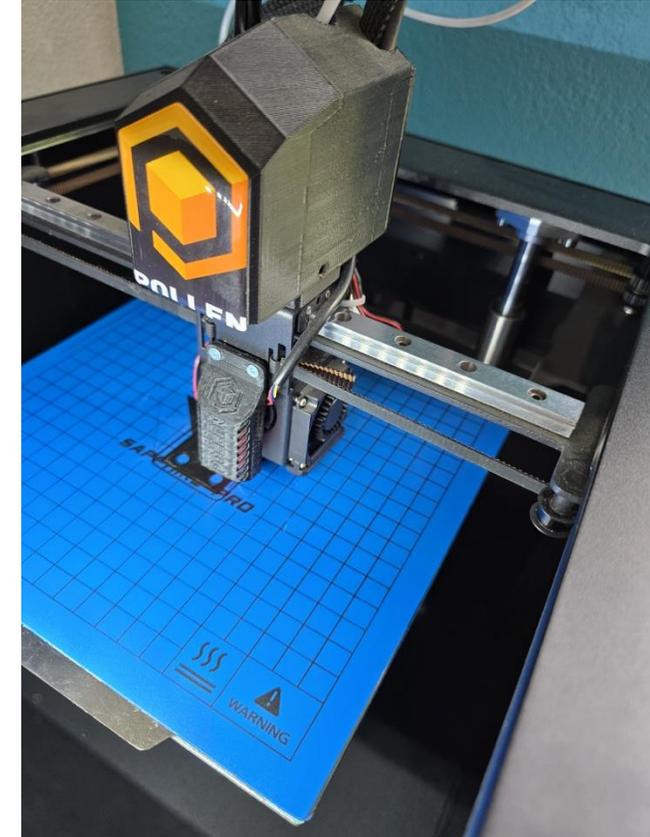
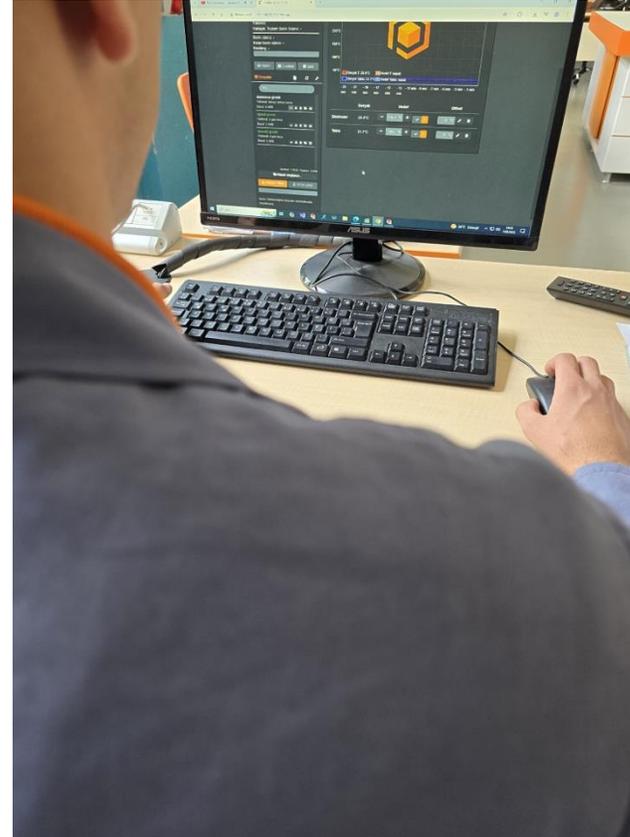
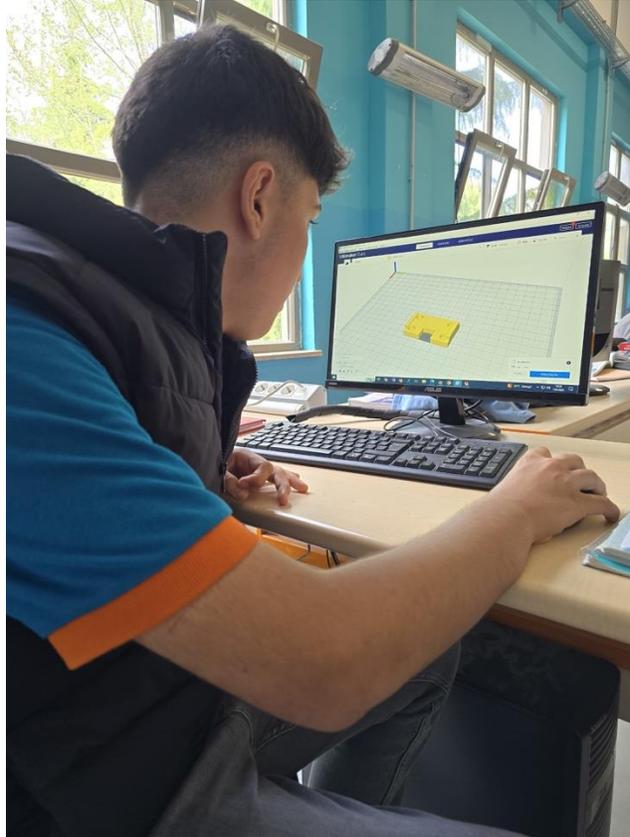
The design of the robot that is being worked on in the project is carried out together with the students using the SolidWorks program.



3D Printing



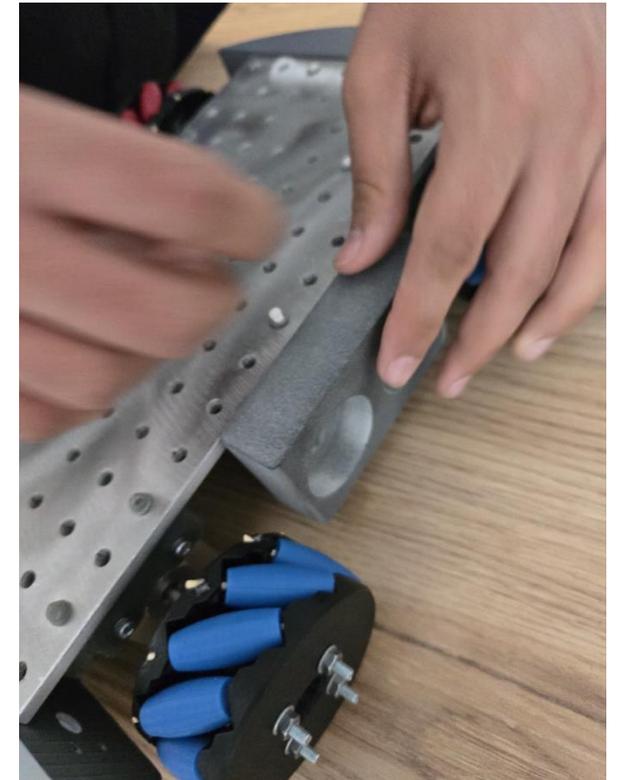
With the active participation of students, the printing and preparation of robot parts designed using a 3D Printer are carried out.



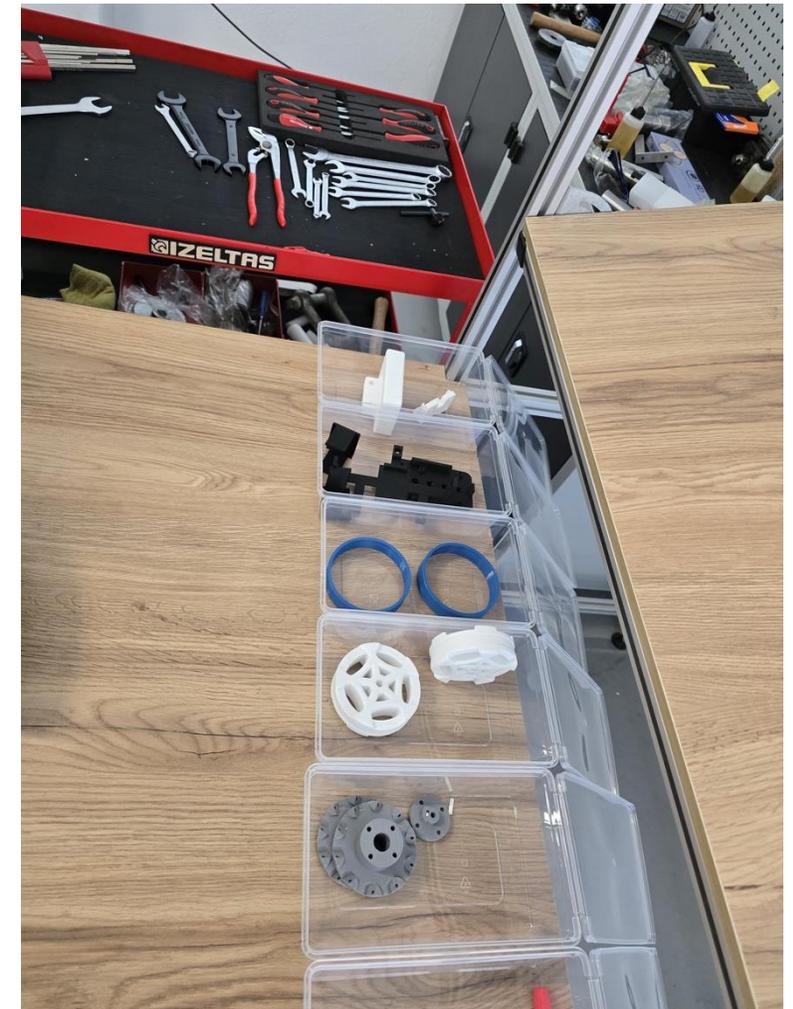
Manual Assembly



On the Manual Assembly Table, assembly operations of previously printed or supplied robot parts are carried out.



Manual Assembly



Courses For CLF



Three courses have been designed to provide training within the scope of CLF within our institute. These are;

- 1-) 3D Designing Training
- 2-) 3D Printing Training
- 3-) Manual Assembly Techniques

Courses For CLF

3D Designing Training



- This 3D Designing with SolidWorks course provides a comprehensive introduction to computer-aided design (CAD) using SolidWorks, one of the industry's leading 3D modeling software.
- The course covers fundamental and advanced SolidWorks features, including sketching, part modeling, assemblies, and technical drawings, as well as parametric design principles. Participants will learn how to create highly detailed 3D models, apply materials, perform simulations, and prepare designs for 3D printing or manufacturing.
- By the end of the course, students will be able to develop professional CAD models, optimize designs for engineering applications, and produce detailed technical documentation for manufacturing processes.

Courses For CLF

3D Designing Training



- This course provides a practical and theoretical foundation in 3D printing (additive manufacturing), covering the entire process from design to post-production. Students will gain hands-on experience with 3D modeling, slicing software, printer operation, troubleshooting, and material selection.
- The course explores different printing technologies (FDM, SLA, SLS), real-world applications in engineering, healthcare, and product design, and advanced techniques such as multi-material printing and 3D scanning.
- By the end of the course, students will be able to design, optimize, and print functional 3D models and understand how to apply 3D printing in professional environments.

Courses For CLF

Manual Assembly Techniques



- This course focuses on the fundamental skills required for manual assembly in industrial and manufacturing environments. It covers essential techniques, tools, and best practices for assembling mechanical and electronic components by hand.
- Through hands-on activities and theoretical lessons, students will learn how to assemble complex systems with precision, ensuring both quality and safety standards are met.
- The course is designed for students and professionals seeking to enhance their technical skills in manual assembly, commonly applied in sectors such as automotive, electronics, and machinery manufacturing.

THANK YOU.



LCAMP CLF Concept By DHBW Heidenheim

Prof. Dr.-Ing. Klaus-Dieter Rupp
Dipl.-Ing. Ralf Steck
Jan Stenzel, M.Ed.

2025-05-12

LCAMP CLF concept by DHBW



**We would like to invite you to join our CLF journey
@ DHBW in Germany**

What is our target group and educational scope?

- EQF 6-7 HVET
 - Bachelor of Engineering
 - There are 24 degree programs in the following faculties:
 - ✓ Faculty of Health Studies
 - ✓ Faculty of Social Work
 - ✓ Faculty of Technology
 - ✓ Faculty of Economics
 - **NEW** Master of Science Program
“located@Heidenheim”



located@HEIDENHEIM

Master
Wirtschaftsingenieurwesen
located in Heidenheim
kennenlernen

- 📅 4 Semester
- 🎓 Master of Science
- 🏠 Am Standort Heidenheim
- 📅 Ab Wintersemester 2025/2026

Image source : Derived from DHBW HDH Homepage

What means collaboration for us?

- **Students / Learners Use Advanced Manufacturing Technologies**
- **Transcultural Teams**
- **Collaborative Problem Solving**
- **Multilingual Communication**
- **Become Acquainted With International Working Culture**



Image source : Derived from DHBW HDH Homepage

What defines our CLF at DHBW Heidenheim?

Advanced Manufacturing Technologies

- 3D Printer
- 3D Scanner
- Cutting Technologies (Laser/ Water Jet)
- CNC Milling
- AR-Assembly
- Collaborative Robot
- Bosch MPS (Sensor Assembly)

Advanced Process Technologies

- Product Configuration
- MES, Node-Red
- Digital Twin (URDF, MQTT, OPC/UA)
- Solid Works / Siemens NX
- LMS Moodle
- ROS (Robot Operating System)

Didactical Premisses

- Human- / Lerner-Centric, CBE (Competency Based Education)
- Open For Internationalization
- Flexible/ Scalable (Open Curriculum)
- Lifelong Learning
- Multifaceted Learning-Environments
 - *Blended Learning*
 - *Experiential Learning*
 - *Collaborative Learning*
 - *Open Learning*
- Ready For EDC (European Digital Credential) Infrastructure



Image source : Derived from DHBW HDH Homepage

How the DIDACTICAL principles define our approach?

The didactical setting & line-up of the manufacturing technologies utilized along the CLF shall equip the learner with targeted skills to address and solve (future) real-world problems of the manufacturing sector such as:

- **Customer Orientation** → Customer Focus, Adaptability, Process Orientation
- **Product Configuration** → Knowledge graph-based connection-driven product configuration
- **MES Process Configuration** → MES Logical Sequence: Input/Output/Systems by FORCAM
- **Human-Centred Learning Environment** → Blended Learning, Experiential Learning, Collaborative Learning
- **Assembly with AR assistance** → Using ARKITE as our common international part of the LCAMP CLF
- **Structure of LCAMP Logistics** → Reflecting Industrial SCM
- **Micro-Credentials linked to the CLF** → According to European Standards
- **Circular Economy / Supported Processes** → LCAMP integrates circular economy principles directly into the development of learners' skills.

Customer Orientation

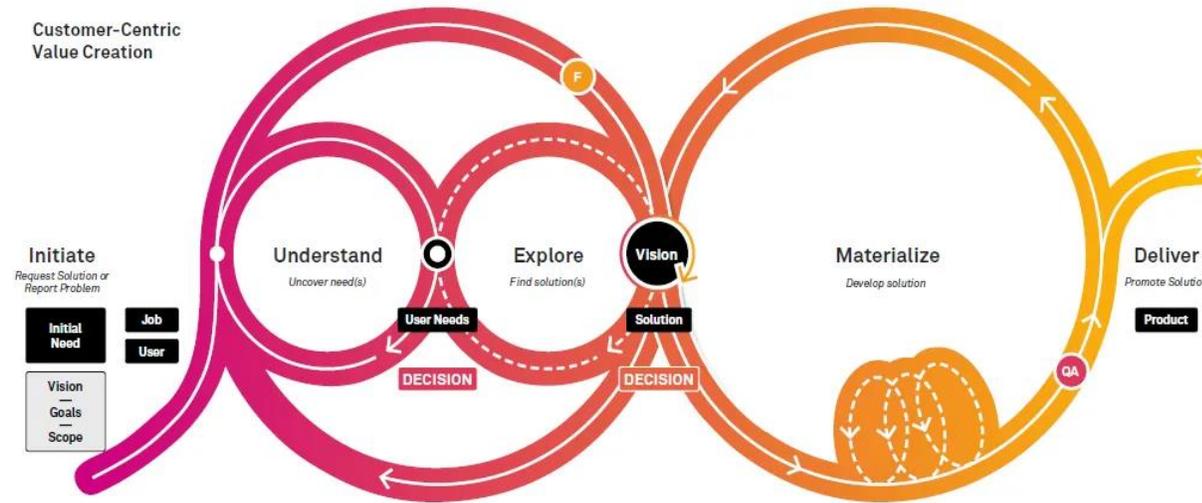


Image source : Derived from <https://juanfemandopacheco.com/2025/04/customer-centric-value-creation/>

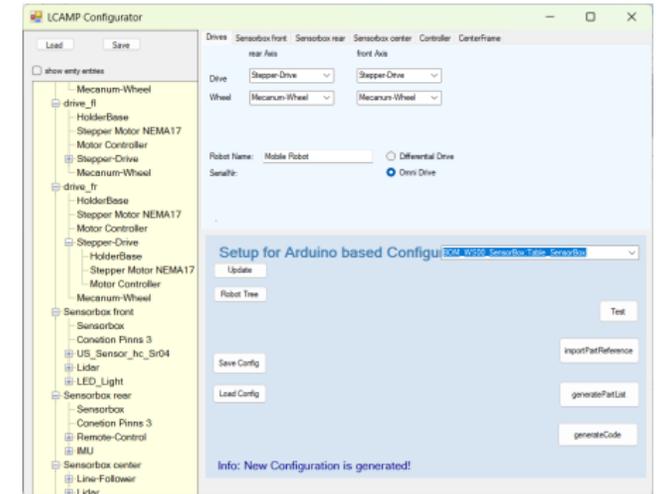
- **Customer Focus:** All stakeholders along the process chain are regarded as customers to create value together.
- **Adaptability:** Adaptability drives innovation throughout the entire product life cycle.
- **Process-Oriented Systems:** Configurable, process-oriented systems promote circular value within the circular economy.
- **Customer Journey & Quality:** Quality arises from meeting real customer needs – essential for fulfilling expectations.
- **Customer Experience Enhancement:** Data-driven optimization of the customer experience increases satisfaction, loyalty and competitive advantage.

Product Configuration

Configuration
LCAMP Robot

Knowledge graph-based connection-driven product configuration

A contextual and circular product configurator structures multi-variant products using a complex bill of materials system based on a multi-dimensional knowledge graph. Individual parts and assemblies are modelled as exclusive 'item variants', enabling durable and maintainable product design through modular, sustainable materials. The configurator links product structure, assembly planning, digital twins and learning content via platforms such as Moodle and Simumatik. It simultaneously supports industrial production and collaborative learning factories through the end-to-end integration of PDM, MES and AR systems. The configuration is didactically supported by simultaneous engineering, feedback loops and standardized learning modules.

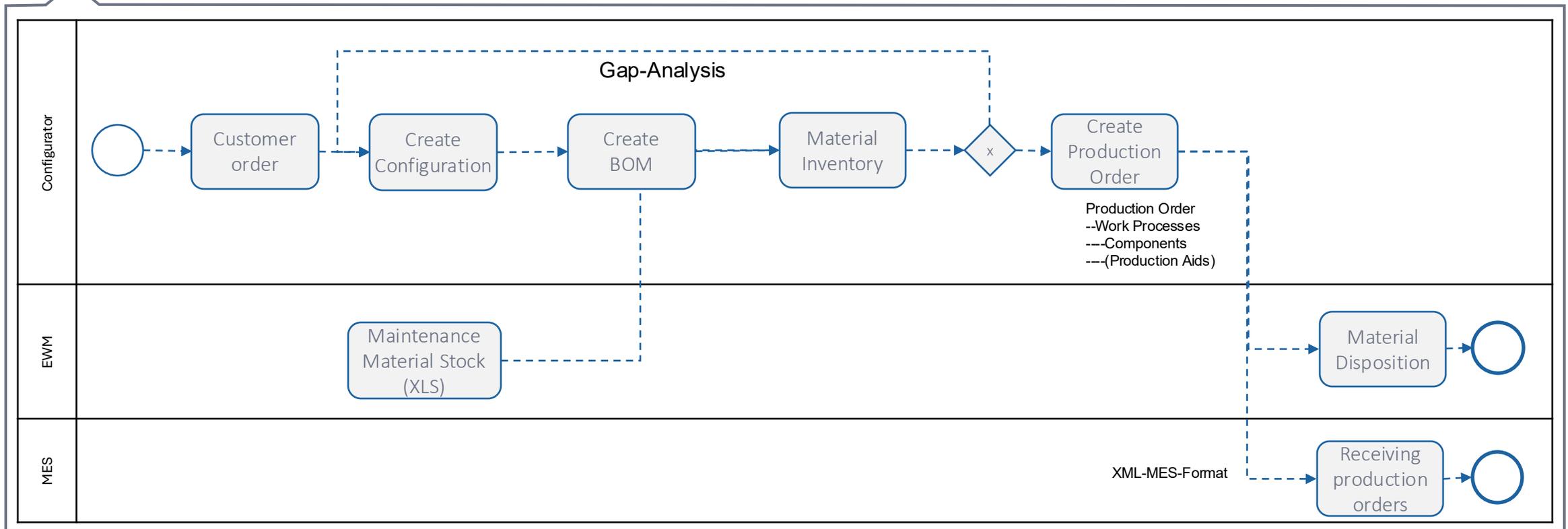


Source : Prof.-Dr. K.-D. Rupp / Configuration Manager for a Collaborative Learning Factory, CLF2025

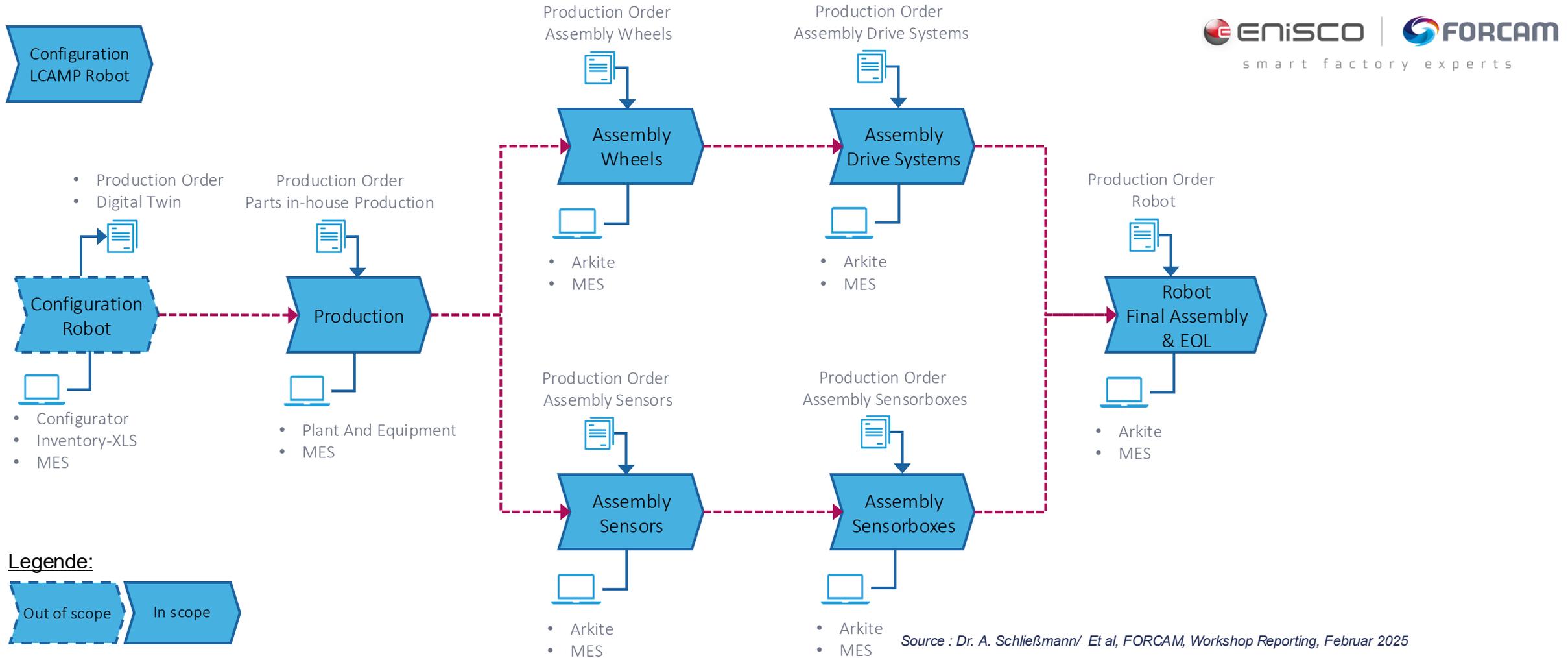
DHBW – MES Process Configuration

Configuration
LCAMP Robot

“Learning about production-related configurations enables cognitive activation that corresponds to real industrial requirements” (Abele et al., 2017).

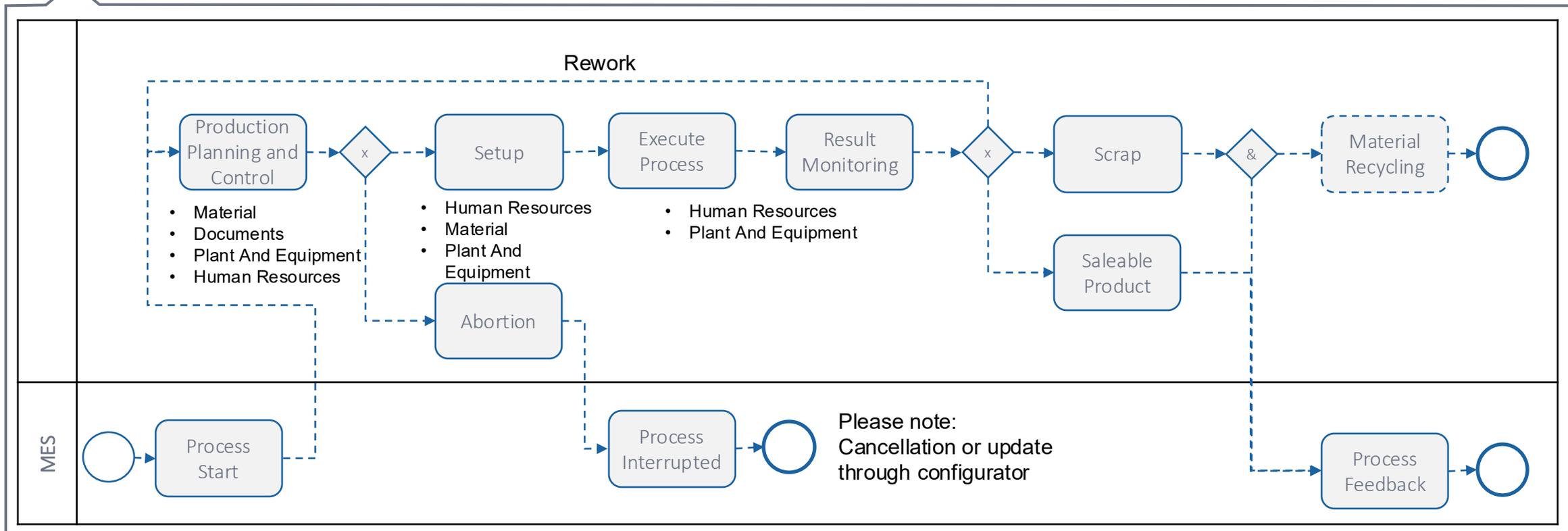


DHBW – MES Logical Sequence: Input/Output/Systems

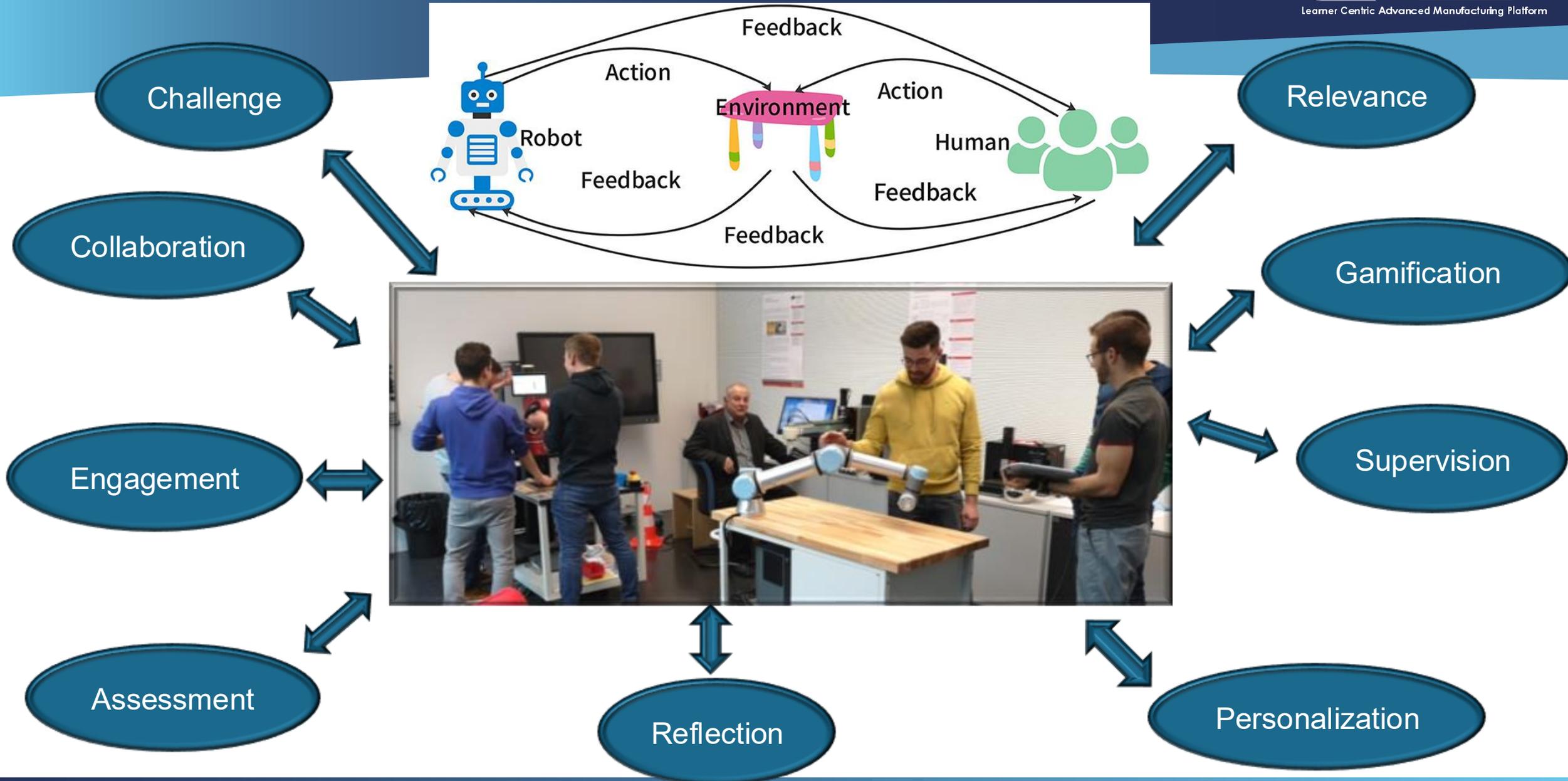


DHBW MES - Draft Process module – „Common Work Process“

General



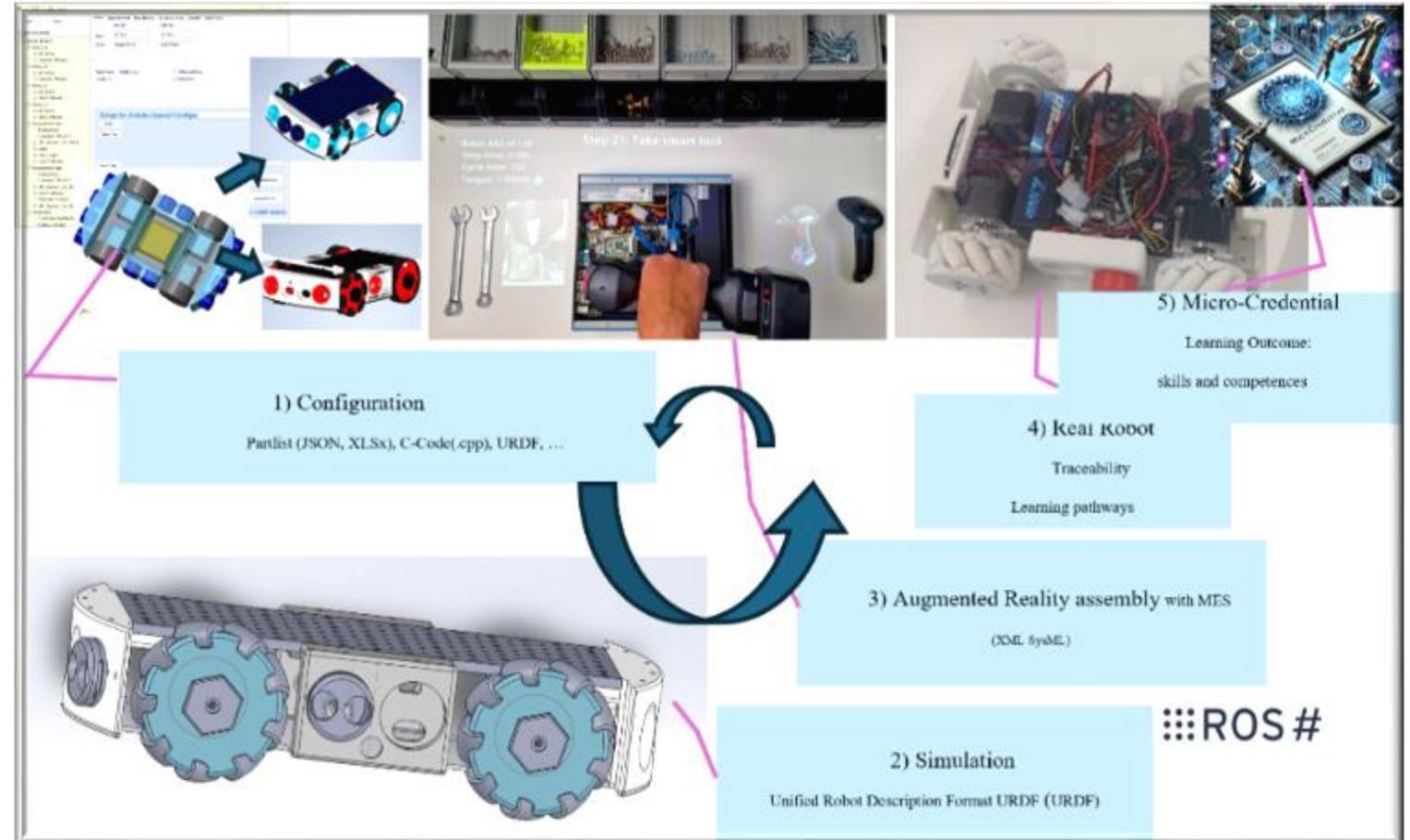
Human-Centred Learning Environment



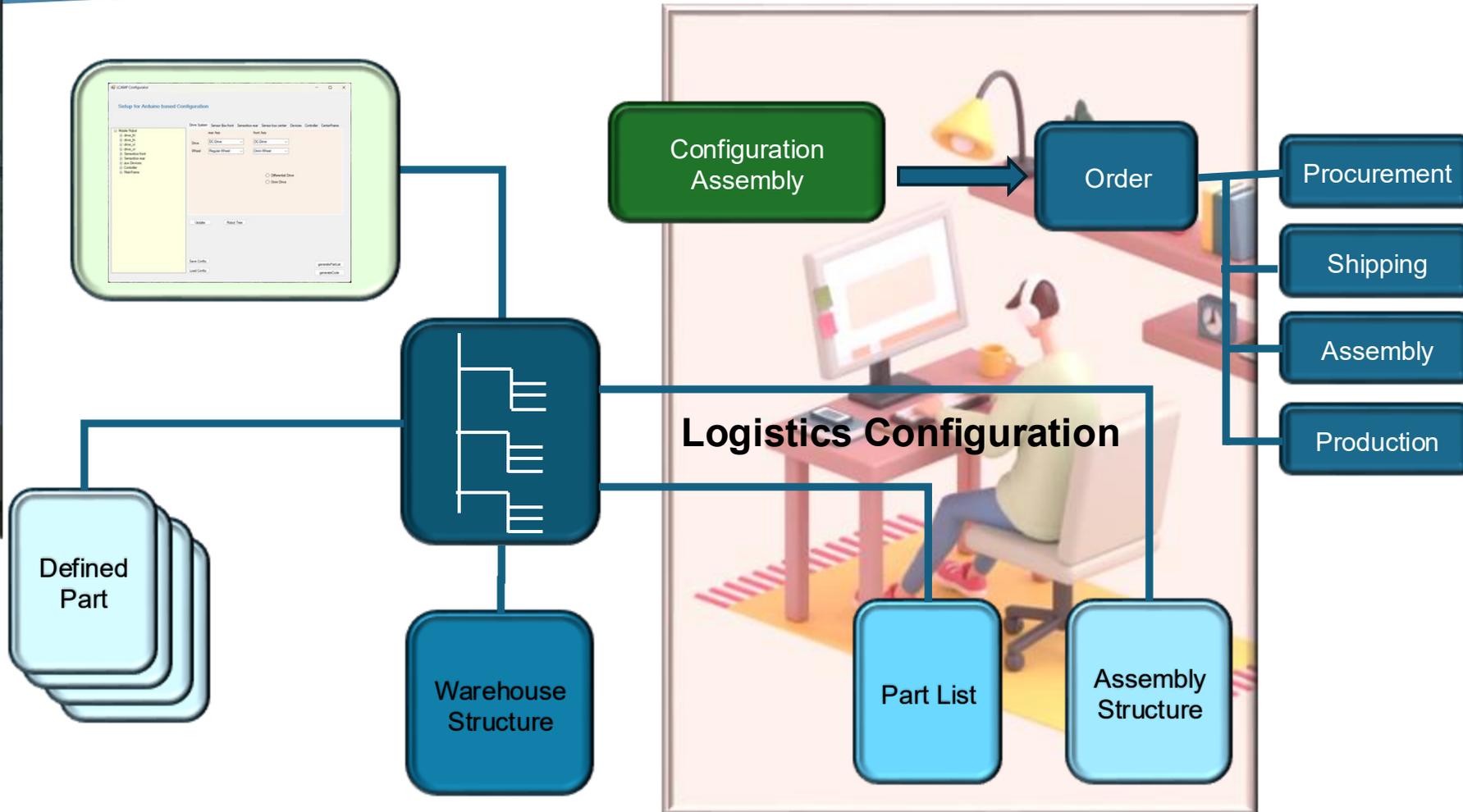
Assembly with AR assistance based on the selected configuration

Configurator output format description:

- 1) Robot Description
 - *.JSON
 - *.XLSX
 - *.CPP
- 2) Simulation
 - *.URDF
 - *.SLX
- 3) Assembly With MES
 - *.XML, (SYS ML)
- 4) Real Robot
 - *.PDF
- 5) Micro-Credentials
 - *.PDF-XML (*Europass*)



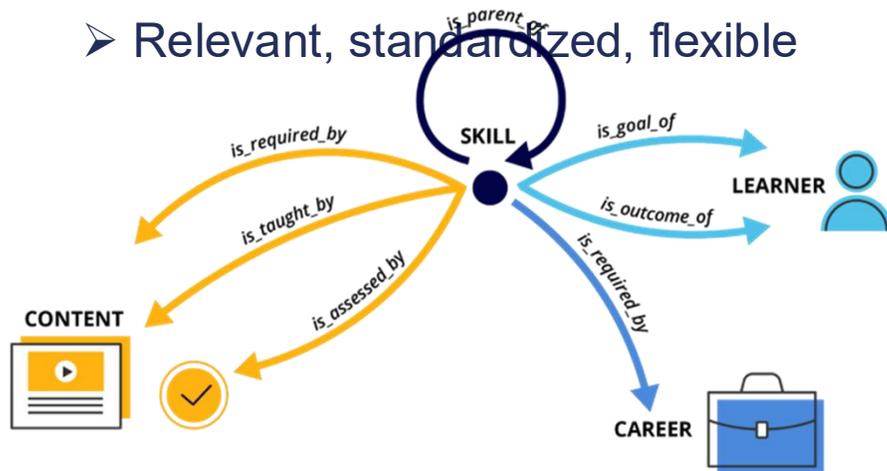
Structure of LCAMP Logistics



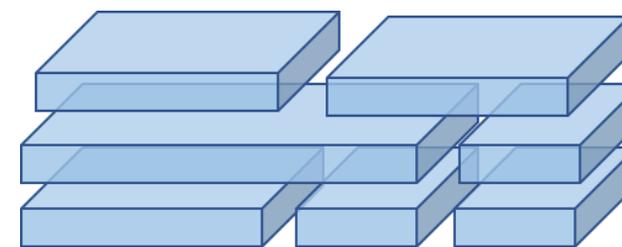
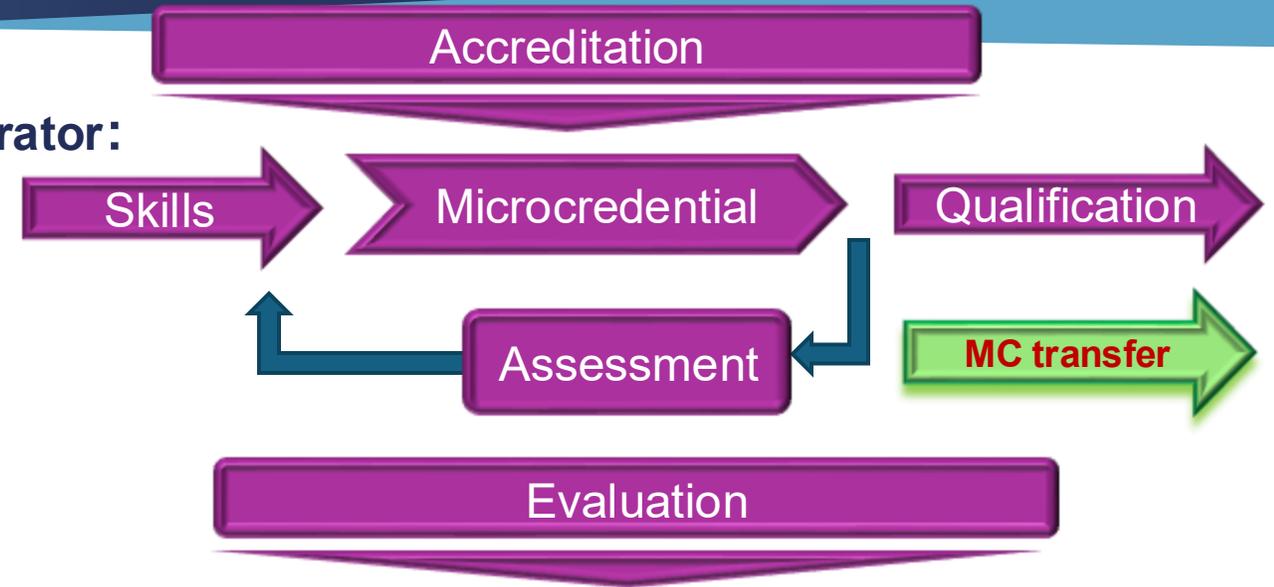
Micro-Credentials linked to the CLF

This is managed in collaboration with the Configurator:

- Embedded in the accreditation system
- MC belongs to the student
- Can be integrated into a program
- Can be credited only once
- Relevant, standardized, flexible



Source : The original source of this graphic has not been clearly identified despite extensive research (including Google Reverse Image Search).



MC

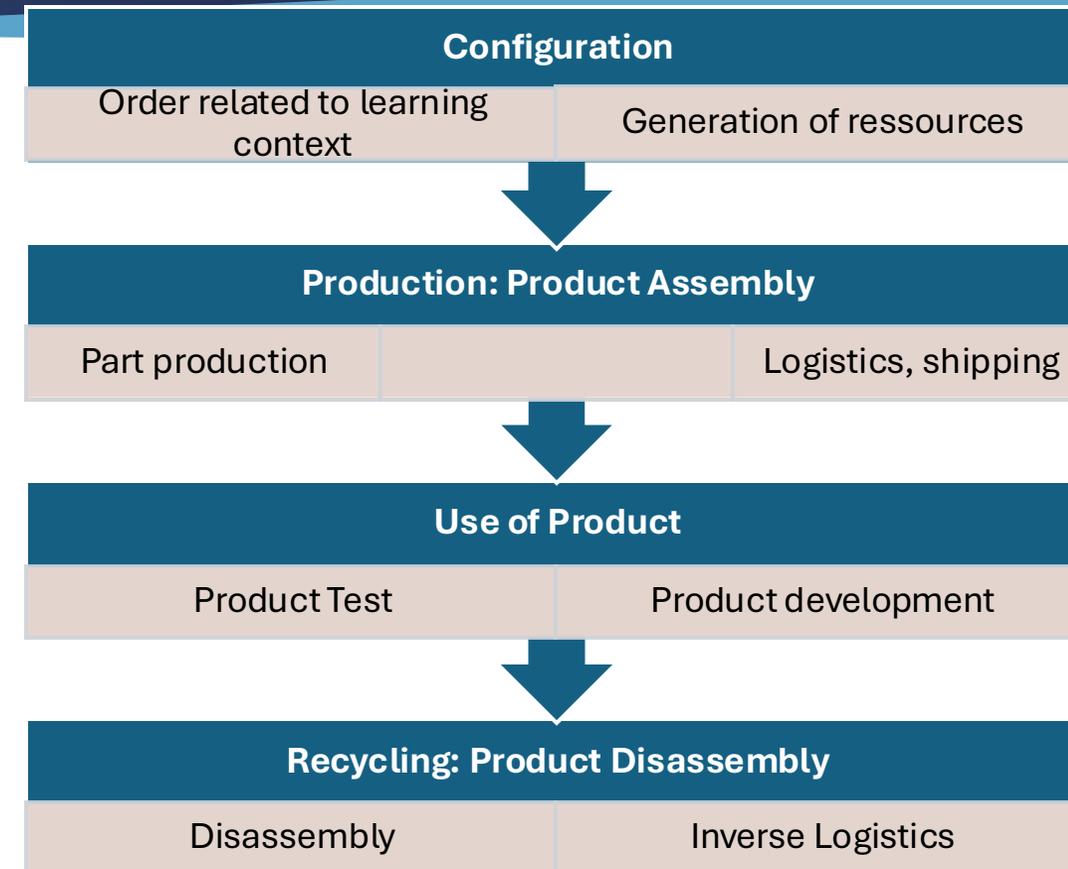
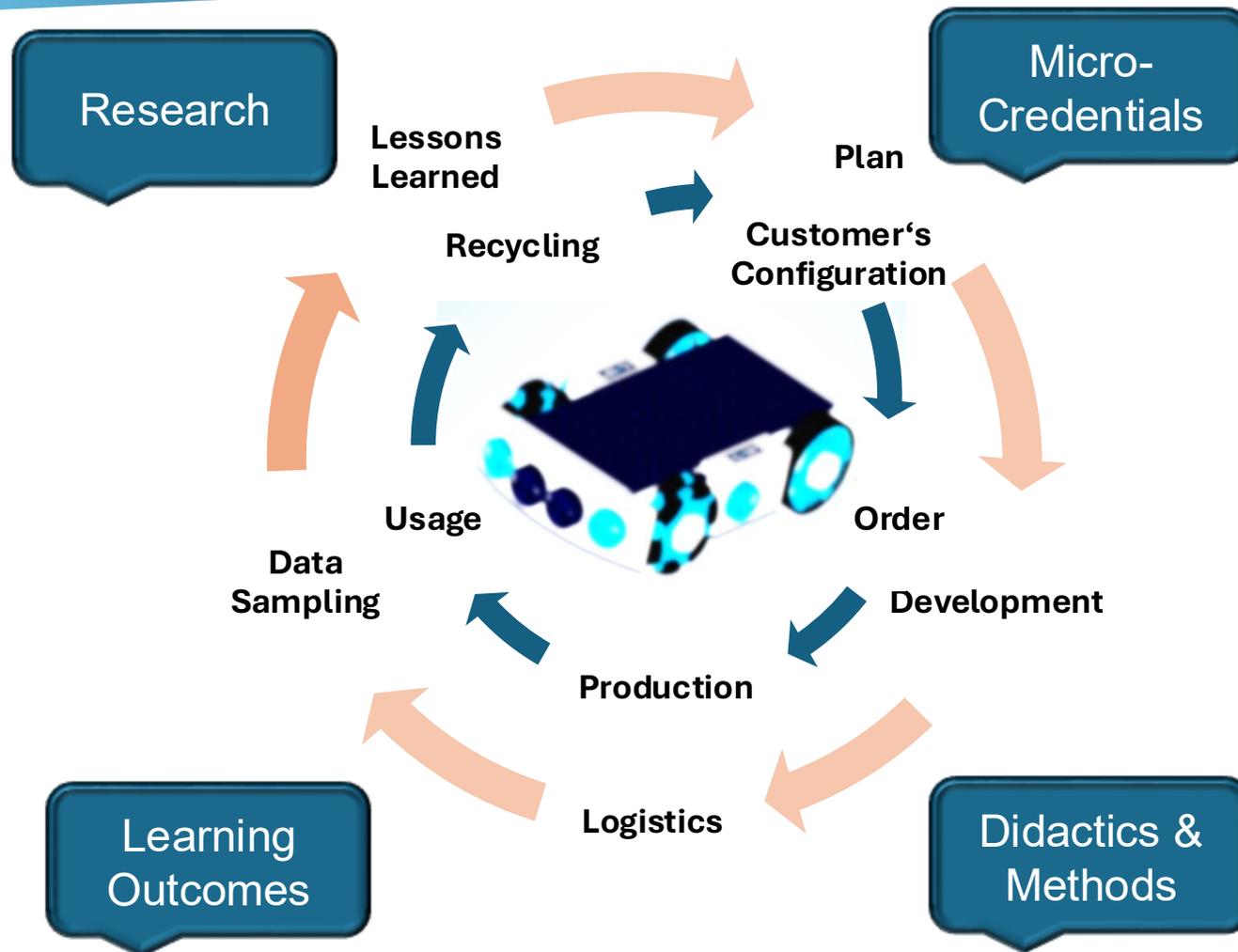
Stack 5..30ECT

Bundel 5..6 ECTS

Source : Prof.-Dr. Rupp/ DHBW HDH, own photographs / designs and graphics, 2025

Microcredentials allow for the formally reliable documentation of small-scale competences. In the context of the European education agenda, they are seen as flexible, modular qualification building blocks. (European Commission, 2020).

Circular Economy / Supported Processes



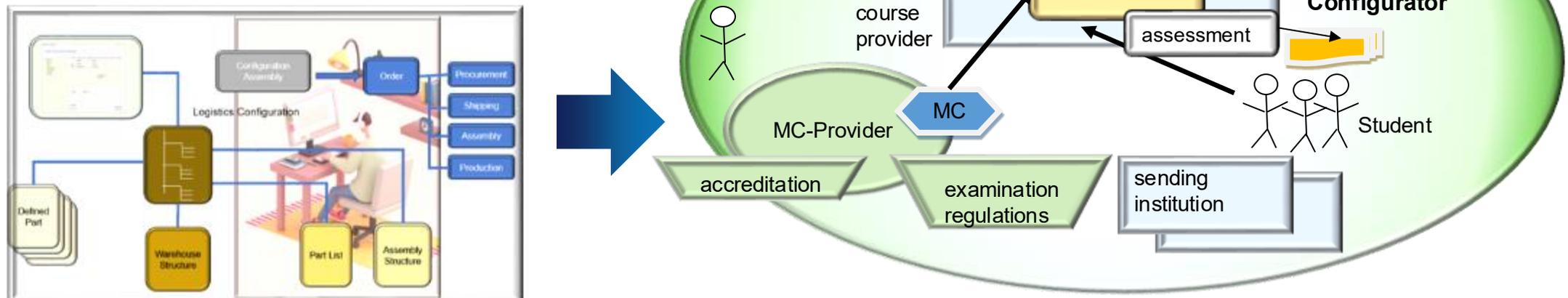
Education for sustainable development is increasingly being called for as an integral part of technical education (UNESCO 2022). LCAMP integrates circular economy principles directly into the development of learners' skills.

Conclusion

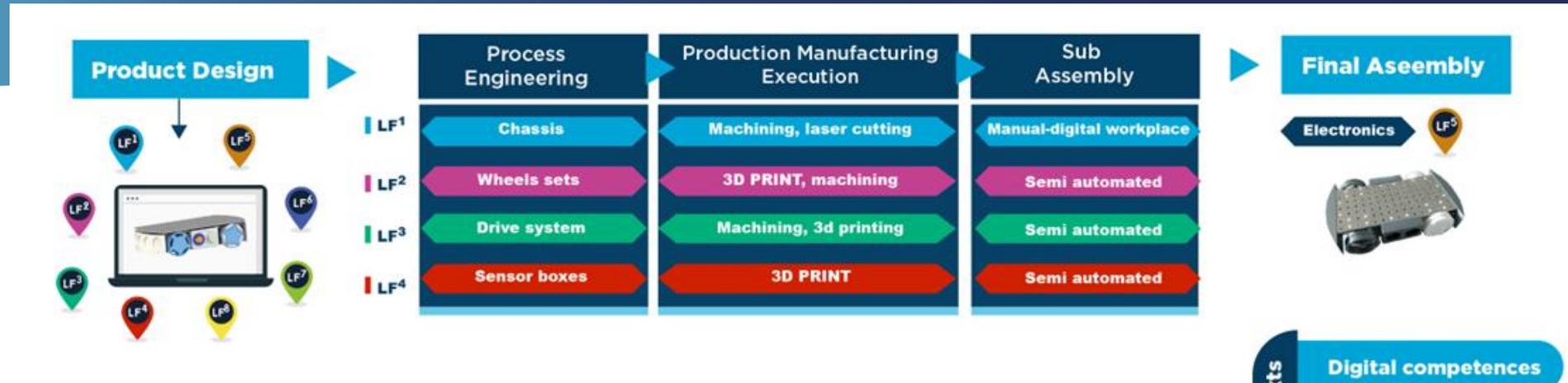
The Configuration Manager is an essential building block in the Collaborative Learning Factory. It connects product structures with production. Learning content and processes are linked on the LCAMP platform. As it is open-source software, it can be adapted to the requirements of different products and learning factory environments. The open-source Configuration Manager, along with its associated processes, can become the foundation for Learning Factories with high production variance and the circular economy aspect

The next steps are:

- Extend connectivity to other tool chains such as 3D-Experience, FORCAM MES, Matlab, Simscape, Simumatik, ARKITE
- Extension for full traceability in the circular economy (second or third life)
- Integration of AI tools on the LCAMP innovation alliance
- Integration of a Brand Manager (under development)

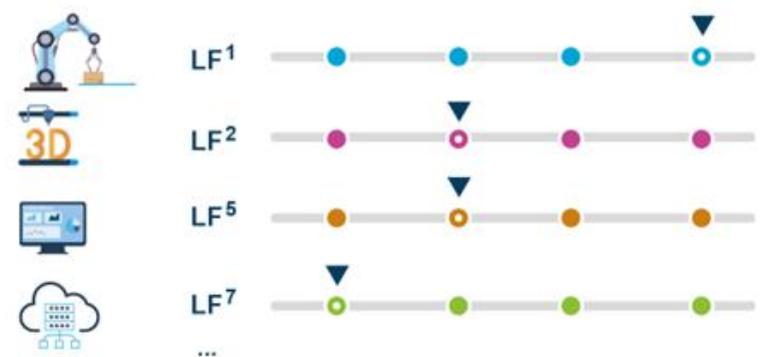


Collaborative Learning Factories For Digital Production: The Cooperative Manufacturing In Industry 4.0



The connectivity of LFs allows the traceability of the production process. All LFs can check the status of the tasks

14.0 enabling technologies implemented In each Learning Factory



- Didactics of the Collaborative LF in VET/HVET contexts**
- Digital competences**
 - Digital workplaces
 - Virtualization
 - Data exchange
 - Joint design
 - Digital twins
 - Virtual collaboration
 - Information literacy
 - Profession Related Competences**
 - Technical skills
 - Instructional training
 - Modular and flexible trainings
 - Learning pathways
 - Microcredentials
 - International students groups

This is why we are promoting CLFs in LCAMP.

**Thank you very much for joining our CLF journey
@ DHBW in Germany**



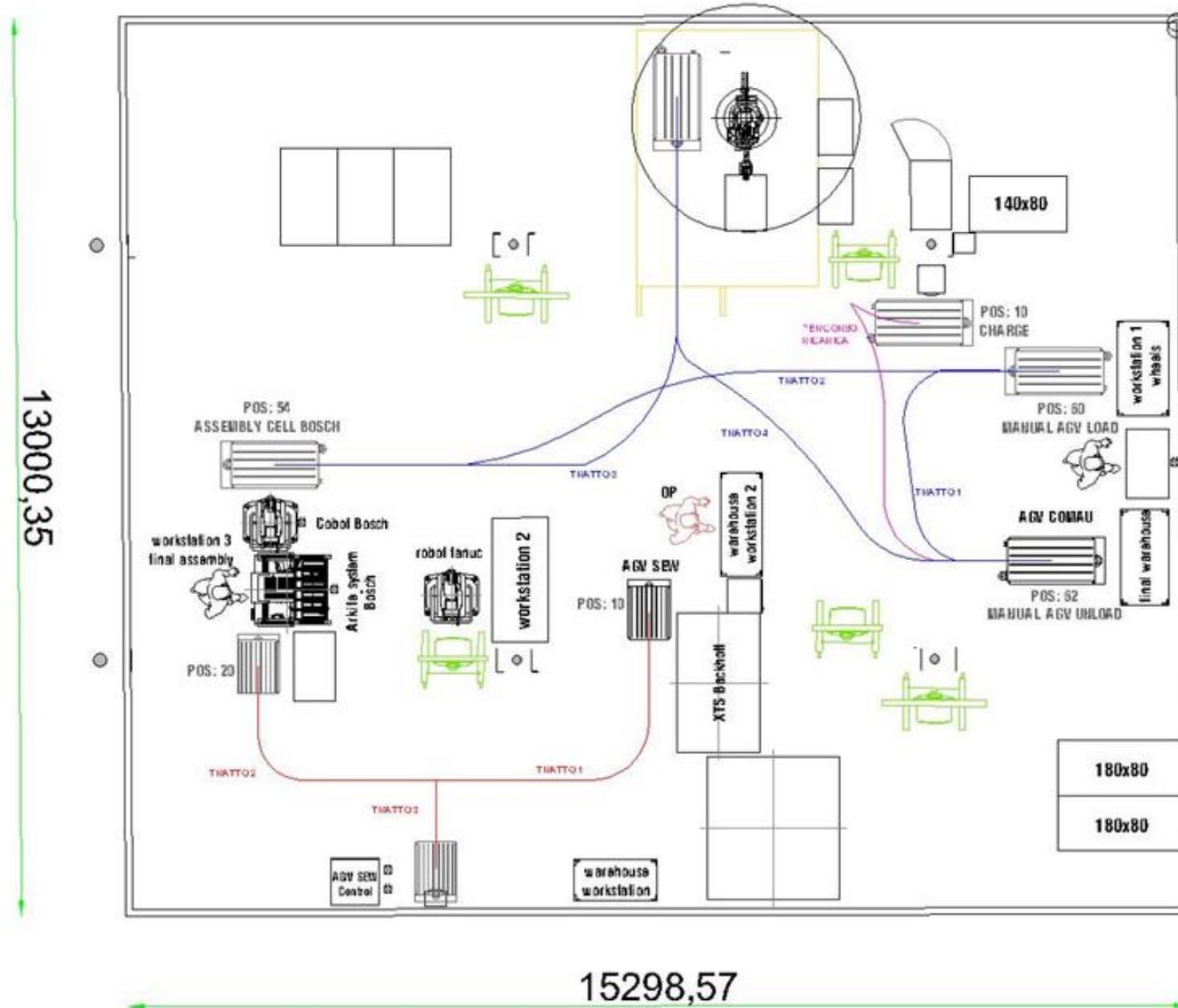
Source : ChatGPT4.0 / own graphic / prompted by Ralf Steck / April 2025

Collaborative Learning Factory by MADE

Matteo Barbarossa

2025-05-12

Learning Factory MADE



Learning Factory MADE

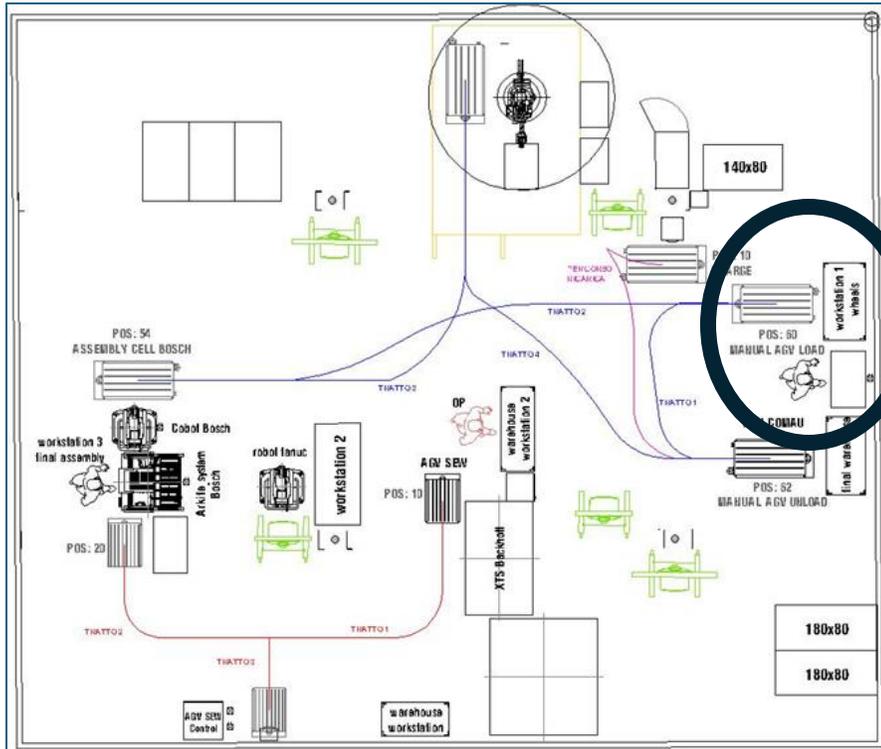


WORKSTATION 1 – Wheels Assembly

At this station, the operator assembles the wheels required for the robot. There are three different types of wheels used:

- Standard wheels
- Mecanum wheels
- Omni wheels

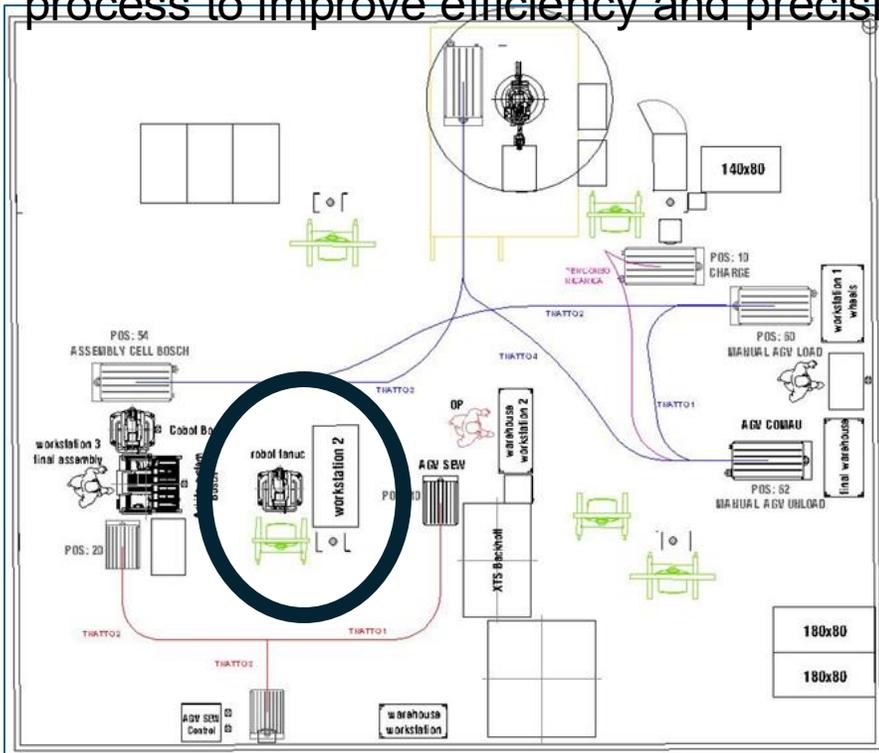
Throughout the assembly process, the operator is guided and supported by **augmented reality through Microsoft HoloLens**. This system provides step-by-step visual instructions, overlays, and real-time assistance, ensuring accurate and efficient assembly of each wheel type.



Learning Factory MADE

WORKSTATION 2 – Chassis Assembly

At this station, the operator assembles all structural components of the chassis as well as some . The operator is assisted by a **Fanuc CRX-10 collaborative robot**, which supports and facilitates the assembly process to improve efficiency and precision.



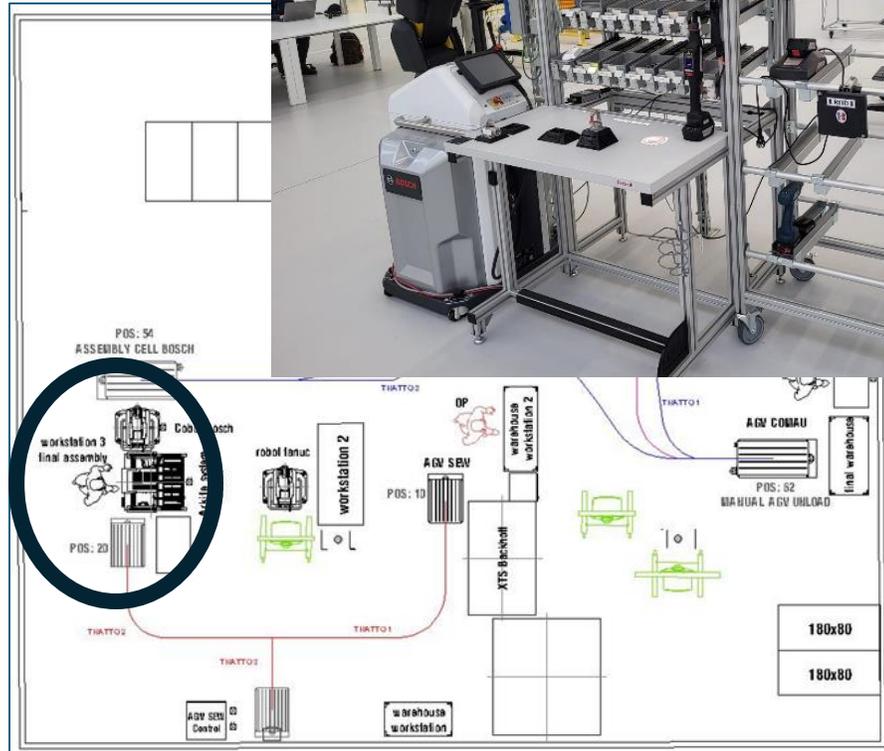


WORKSTATION 3 – Electronics and Final Assembly

Station 3: Electronics and Final Assembly

In this station, the operator installs all electronic components inside the chassis assembled in Station 2. The operator also completes the final assembly by mounting the wheels prepared in Station 1.

The entire process is supported by **Arkite's assisted assembly system**, which provides real-time guidance and ensures accuracy throughout the operation.

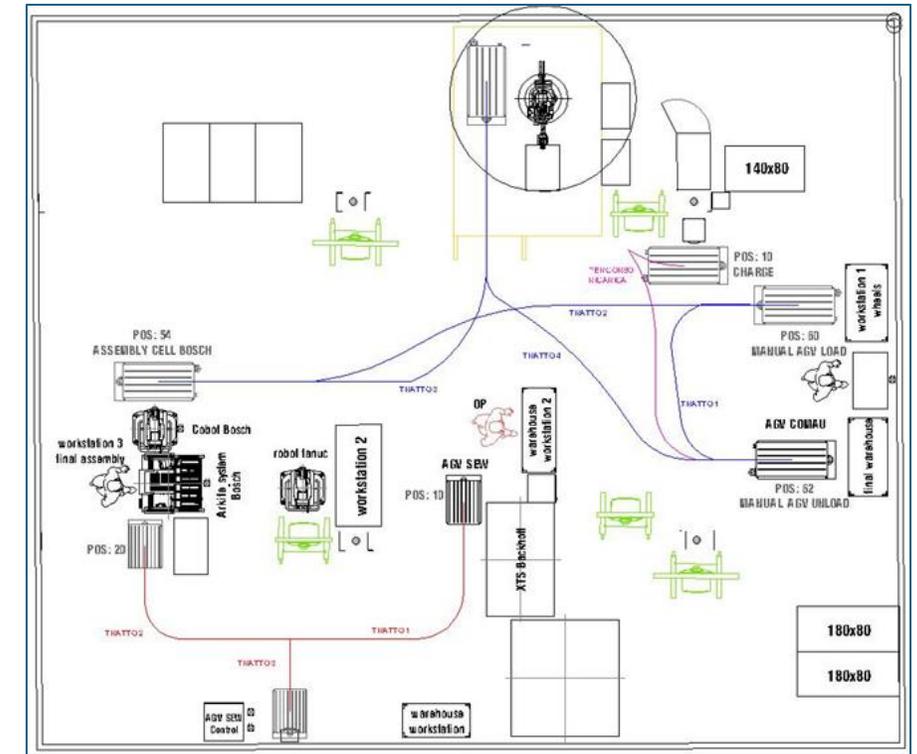
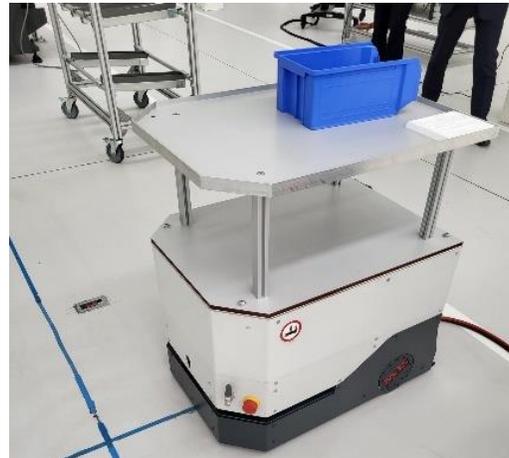
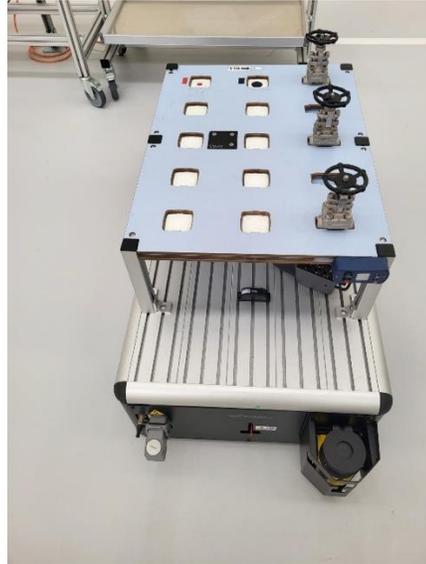


Learning Factory MADE

Logistics

Logistics between the stations are managed by **two AGVs (Automated Guided Vehicles)**, which transport components from Station 1 and Station 2 to the final station.

In addition, each station is equipped with a **dedicated storage area** where operators can pick up the necessary components for their tasks.



Collaborative Learning Factory

Jon Busto

European project officer

www.tolosaldealh.eus



WHO WE ARE

- Click to edit Master text styles
 - Second level
 - Third level
 - Fourth level
 - Fifth level



PROJECT'S PRINCIPLES

The CLF project is conceived with a medium- and long-term vision, but from its inception and design, the following principles have been identified:



Learning process

The **student's learning process** shapes the project, not the other way around



Constant evolution

It is a living project in **constant evolution**



Starts from scratch

Each year it **starts from scratch**



Scalable

It is **scalable**



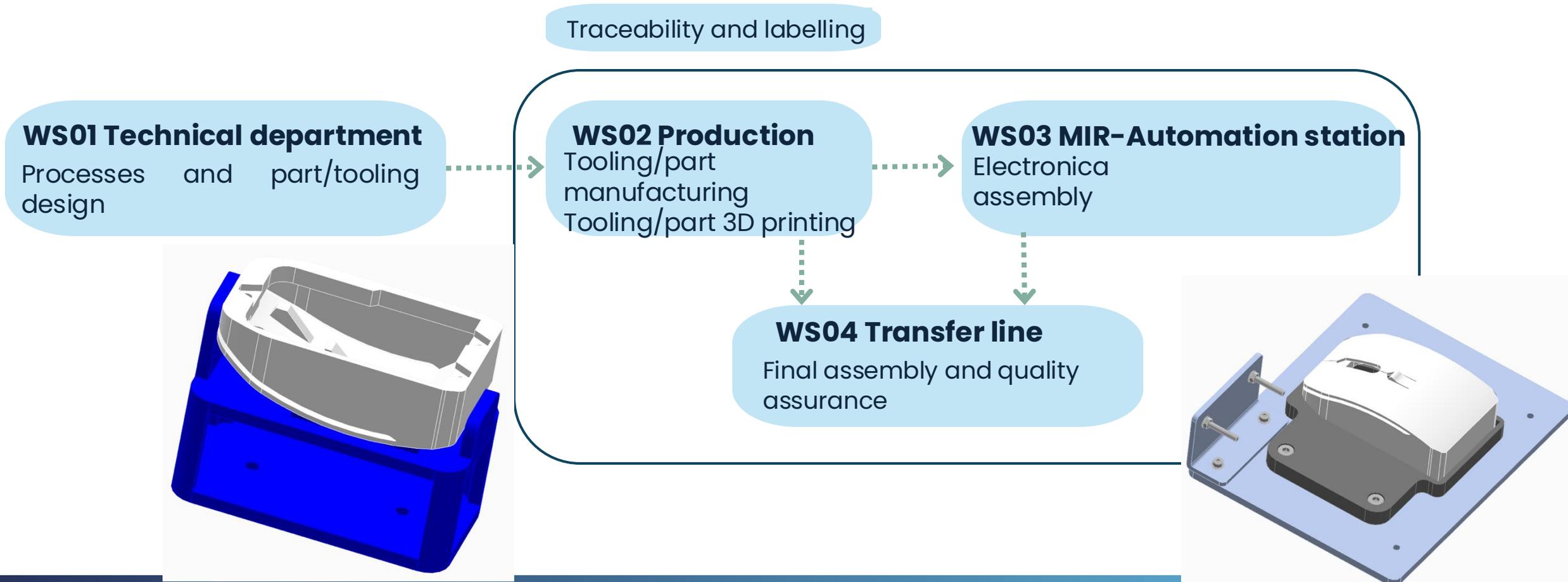
No bound

It is **not bound to the final product**

OUR CLF

TARGET	WHO	SME-SCHOOL	WHEN	HOW
To train students in interdisciplinary industrial 4,0 applications.	Students of design, mechatronics, and automation/collaborative robotics (EQF levels 4-5).	To mutually provide feedback at both technological and educational levels, as well as to have exemplary equipment to promote technological monitoring in the region.	We are in processes design to implement it for September 2026.	Multidisciplinary challenge-based learning methodology

Our CLF is designed with an **atomized structure**, where various equipment and specialties converge into a common project and product



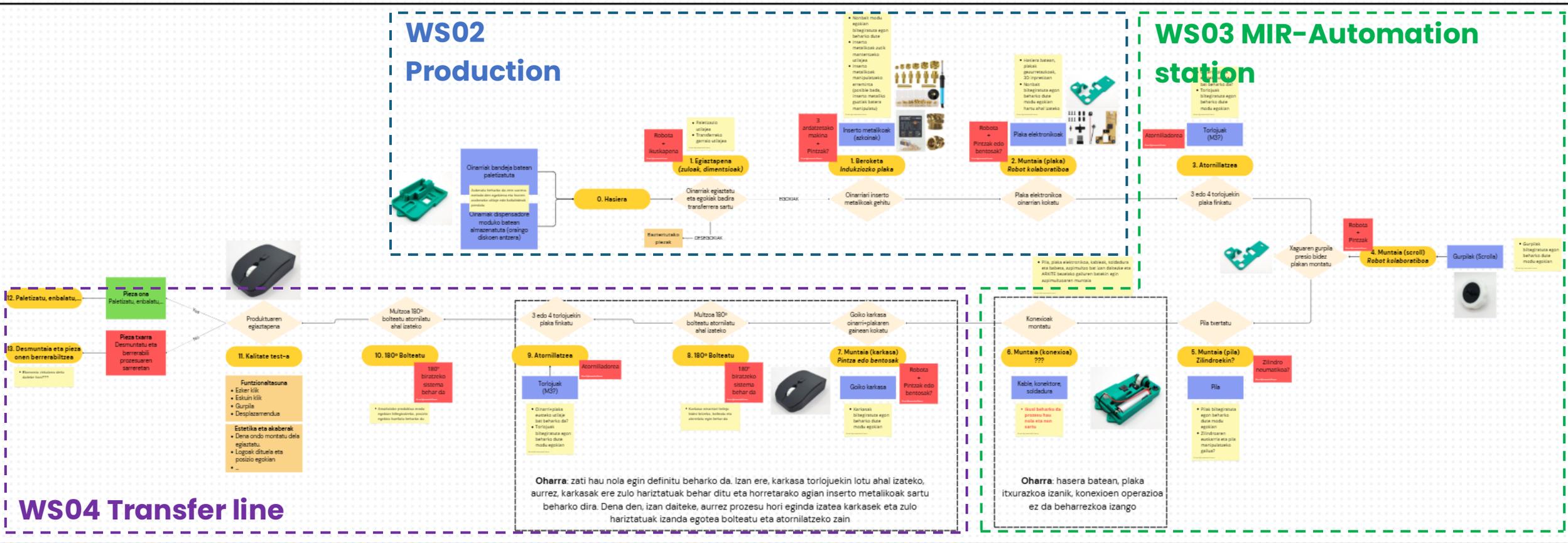
PRODUCT PROCESS DESIGN



WS01 Technical department

WS02 Production

WS03 MIR-Automation station



WS04 Transfer line



Our WS04 transfer line (6 workstations), where the final assembly and quality assurance take place

Thank you

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CAMOSUN COLLEGE CLF OVERVIEW

Imtehaze Heerah

2025-05-13



Learner Centric Advanced Manufacturing Platform



CAMOSUN COLLEGE CLF OVERVIEW

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#LCAMP_EU

2025-05-13



Co-funded by
the European Union



Learning factories in partner's labs

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