



UNIVERSITÀ
DELLA
CALABRIA

DIPARTIMENTO DI INGEGNERIA
MECCANICA, ENERGETICA
E GESTIONALE

DIMEG



human systems
symbiosis lab
<https://uss-lab.it>



Transforming tomorrow:
where minds and machines unite for progress

human-systems symbiosis lab

an **industry X.0** teaching and research laboratory
of the University of Calabria

Visit <https://www.uss-lab.it>



Prof. Antonio Padovano

Associate Professor, Scientific Director USS Lab

**Department of Mechanical, Energy and Management,
University of Calabria**



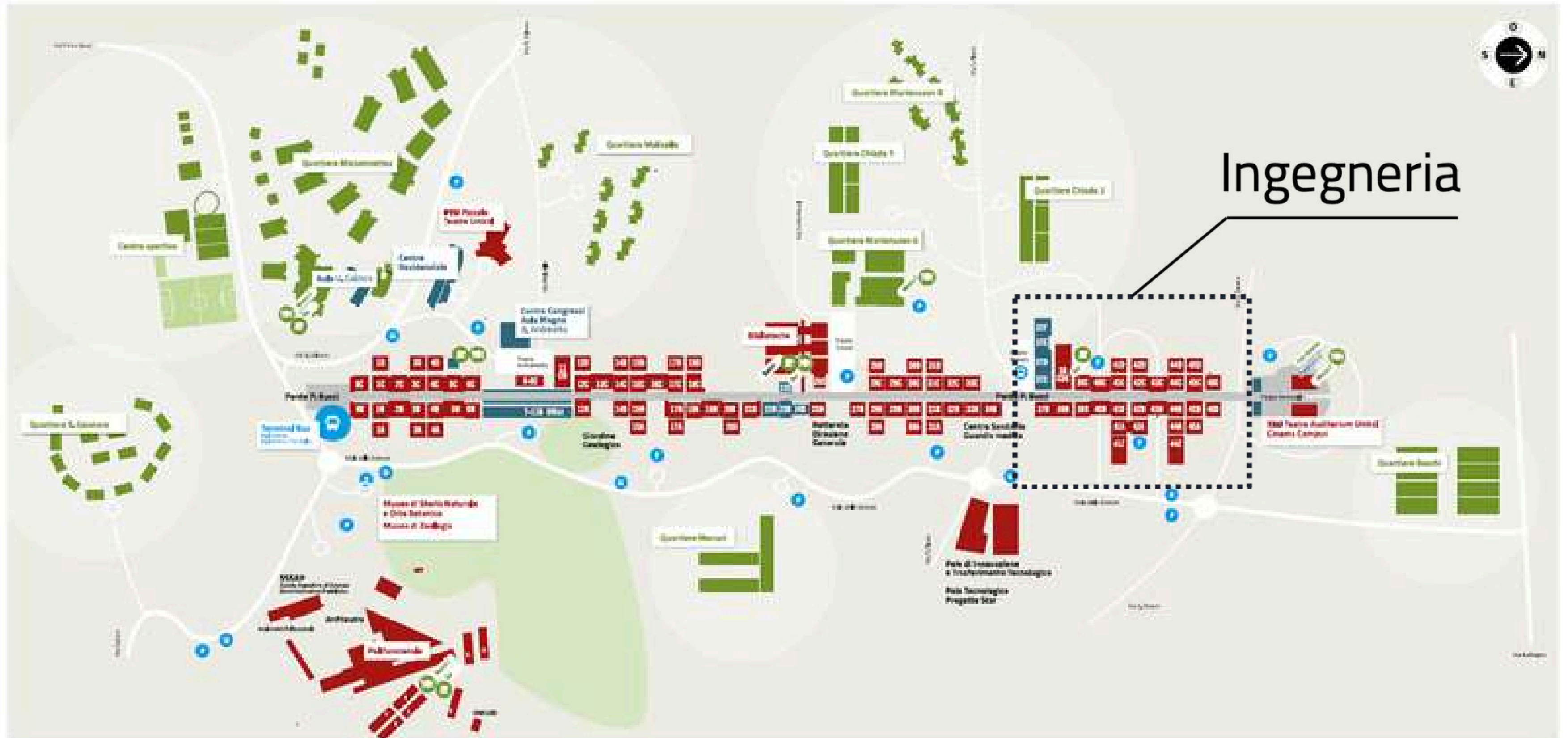
University of Calabria

3rd Largest campus in Italy

Best Provider of student
services in Italy

Source: CENSIS, 2026





Our structure

DIMEG

Key numbers



Research labs

DIMEG

MECH-LAB

**Mechanical Engineering
Laboratory**

- Materials engineering & experimental mechanics
- Mechanism theory, robotics and mechatronics
- Machine elements and industrial design
- Manufacturing technologies

LASER

**Laboratory for Application of
Smart Energy and Renewables**

- Internal Combustion Engines and turbo-machinery
- Computational fluid dynamics
- Environmental and industrial energy engineering
- Electric systems and renewable energy

LIME

**Laboratory of Innovation and
Management Engineering**

- Industrial mathematics and optimization
- Industrial Systems and Production plants management
- Business organization, ICT and decision support
- Supply Chains, Logistics and system planning

Our two lab divisions


UNIVERSITÀ DELLA CALABRIA



DIMEG



Industrial Systems Engineering group (Impianti Industriali Meccanici)

Expertise: Modeling & Simulation, Industry 4.0 & 5.0, Digital Twins, Smart Operators, Extended Reality, Human Robot Collaboration
 Human-centric Decision Support Systems, AI Applications in Production, Logistics and Service Systems, Human-in-the-Loop Digital Twin Technology, Assistive Technologies for Workforce Enhancement, Human-centric & Ethical Tech Engineering, Collective & Emotional Intelligence in Production Contexts, Personnel Training, Development & Upskilling

1 Full Professor

2 Associate Professor

2 Researchers

10+ *Research assistants, PhD students, technical collaborators*



human systems symbiosis lab
<https://uss-lab.it>

Human-Systems Symbiosis Lab (USS Lab)

Research laboratory focusing on human-systems symbiotic interaction, collective intelligence, responsible innovation and research, ethical engineering, and affective computing with applications in smart production and logistics systems and 4.0 systems
Head: Prof. Antonio Padovano



MSC-LES
 MODELING & SIMULATION CENTER
 LABORATORY OF ENTERPRISE SOLUTIONS

Modeling & Simulation Center - Laboratory of Enterprise Solutions (MSC-LES)

Research centre focusing on Modeling & Simulation theory and practice, digital twins in industry and logistics for decision support and education & training
Head: Prof. Francesco Longo

Our key figures

≈ 15

young and senior researchers working in the two labs

5+ Mil€

raised funding and grants (mostly public)

20+

awarded research projects at (inter-)national level

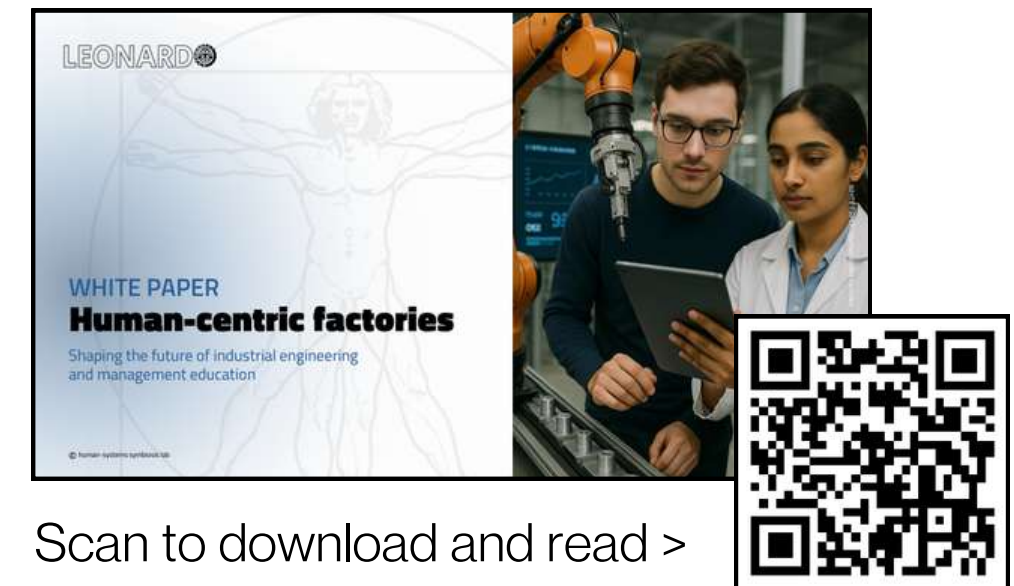
The intersection of humans and technologies



Towards human-centric factories

A white paper from the USS Lab

<https://www.uss-lab.it/projects/leonardo/>



Scan to download and read >

Active collaborations of our lab

50+ ongoing scientific collaborations with worldwide institutions



...among others

Companies (and similar) we work(ed) with



...among others

Our expertise

1 Human-centric Decision Support Systems

Enhancing decision-making processes by combining human cognitive capacities, data interpretability and explainability, the power of simulation and data-driven insights.

2 AI Applications in Production, Logistics and Service Systems

Analyzing data, predict outcomes, and automate tasks, leading to increased efficiency and innovation across diverse industrial domains.

3 Human-in-the-Loop Digital Twin Technology

Combining human and machine intelligence for improved operational efficiency, and continuous performance monitoring of production, logistics and service environments.

4 Assistive Technologies for Workforce Enhancement

Enhancing the capabilities of personnel with enabling technologies, ranging from wearables, knowledge assistants and extended reality, to improve efficiency and safety.

5 Human-centric & Ethical Tech Engineering

Emphasizing responsible and user-centered practices in technology design and development and address the social and ethical implications of emerging technologies.

6 Human-Machine & Human-Robot Interaction

Creating seamless collaboration mechanisms between humans and intelligent systems (machines, robots or devices) to work together harmoniously to achieve shared goals.

7 Collective & Emotional Intelligence in Production Contexts

Investigating solutions for tapping into the collective wisdom of the workforce and fostering emotionally intelligent practices, ultimately leading to improved organizational success.

8 Personnel Training, Development & Upskilling

Developing advanced tools and methods for a skilled, and well-prepared workforce, leading to improved operational efficiency and organizational resilience.

Our key figures

April 2023

when the lab was founded

≈ 1,13 Mil€

raised funding and grants (mostly public)

6

awarded research projects at (inter-)national level

1

smart brewing learning and research lab

Ongoing (or past) R&D projects



ERASMUS+ KA220-HED 2023

LEONARDO

Developing a small-scale brewing factory to teach and experiment with Industry 5.0? LEONARDO has a clear vision to revolutionize IEM education by developing innovative teaching methods, materials, and tools with a human-centric focus.



MUR - PRIN 2022

RESILIENCE

How to enhance industrial training and competence development? RESILIENCE explores how to enhance VR- and simulation-based training for industrial operators using digital twins, BIM data and cognitive models.



MUR - PRIN 2022 PNRR

DESDEMONA

What's the role of the human operator's emotions at an industrial workplace? DESDEMONA investigates how maintenance activities and tasks should be shaped to move towards more human-centric factories.



PRIMA AWP 2023

CERERE

How can we build more resilient cereal supply chain in the Mediterranean area? CERERE leverages digital twins, simulation, IoT, AI and Smart Farming practices to shape the future of agri-food industry.



MIMIT

IOTWINS-VR

How can IoT-driven data and virtual reality be integrated into interoperable and user-friendly twin platform to improve manufacturing and performance of manufacturing systems?

Ongoing (or past) R&D projects



2022
CE
e industrial training and
development?
explores how to enhance
tion-based training for
ctors using digital twins,
ognitive models.



MUR - PRIN 2022 PNRR **DESDEMONA**

What's the role of the human operator's emotions at an industrial workplace? DESDEMONA investigates how maintenance activities and tasks should be shaped to move towards more human-centric factories.



PRIMA AWP 2023 **CERERE**

How can we build more resilient cereal supply chain in the Mediterranean area? CERERE leverages digital twins, simulation, IoT, AI and Smart Farming practices to shape the future of agri-food industry.



MIMIT **IOTWINS-VR**

How can IoT-driven data, simulation, and virtual reality be integrated into an interoperable and user-friendly digital twin platform to improve decision-making and performance in manufacturing systems?



MSCA-DN **UNIQUE**

How can integrated, human-centric digital and circular manufacturing approaches be developed to simultaneously improve industrial performance, environmental sustainability, and worker wellbeing?

Our latest research results

Towards human-centric factories

A white paper from the USS Lab

<https://www.uss-lab.it/projects/leonardo/>



WHITE PAPER / Human-centric factories / Shaping the future of industrial engineering and management education

The engineers and managers we educate today must not only master advanced tools – they must understand how to shape the future of work:

- A **smart workforce** is one that works in harmony with digital technologies. These are workers equipped to collaborate with AI, data systems, and automation tools – not to be replaced by them, but to be empowered by them. Smart workers are mutually learning with AI, digitally literate, and agile in using information to make better decisions.
- A **resilient workforce** is capable of adapting to disruption – whether due to pandemics, supply chain shocks, technological change, or global crises. Resilience involves not just technical flexibility but emotional intelligence, collaboration, and problem-solving under pressure.
- A **sustainable workforce** refers to both human sustainability (well-being, inclusion, work-life balance) and environmental responsibility. This means building a culture that values people, supports long-term growth, and contributes to responsible human-centered transformation.

In short, the factories of the future will only be as intelligent, adaptive, and humane as the people who design and manage them.

And it begins in the classroom—where we must teach not just what engineers can do, but what they should do.

© human-systems symbiosis lab

Preparing engineers for this responsibility means breaking down the barriers between technical and human knowledge.

Designing smart, resilient, and sustainable systems requires more than engineering – it demands an understanding of how technology, people, and organizations interact in complex, often unpredictable ways. Future engineers must be equipped not only with skills in math, physics, and computing, but also with insights from social sciences, psychology, ethics, and organizational studies. Understanding how people think, work, and relate is just as important as knowing how machines function.

We must move beyond the outdated view of engineers as purely technical experts. They must become translators of human values into operational solutions—professionals who build systems that reflect both technological excellence and social responsibility.

Amirghis, G., Filas, L., Lorigo, F., & Padovano, A. (2022). Workforce and supply chain disruptions in a digital and technological innovation scenario for resilient manufacturing systems in the COVID-19 pandemic. *Computers & Industrial Engineering*, 169, 108118.

Lorigo, F., Padovano, A., & Ortolano, S. (2023). Value-Oriented and Ethical Technology Engineering in Industry 5.0: A Human-Centric Perspective for the Design of the Factory of the Future. *Applied Sciences*, 13(12), 6182.



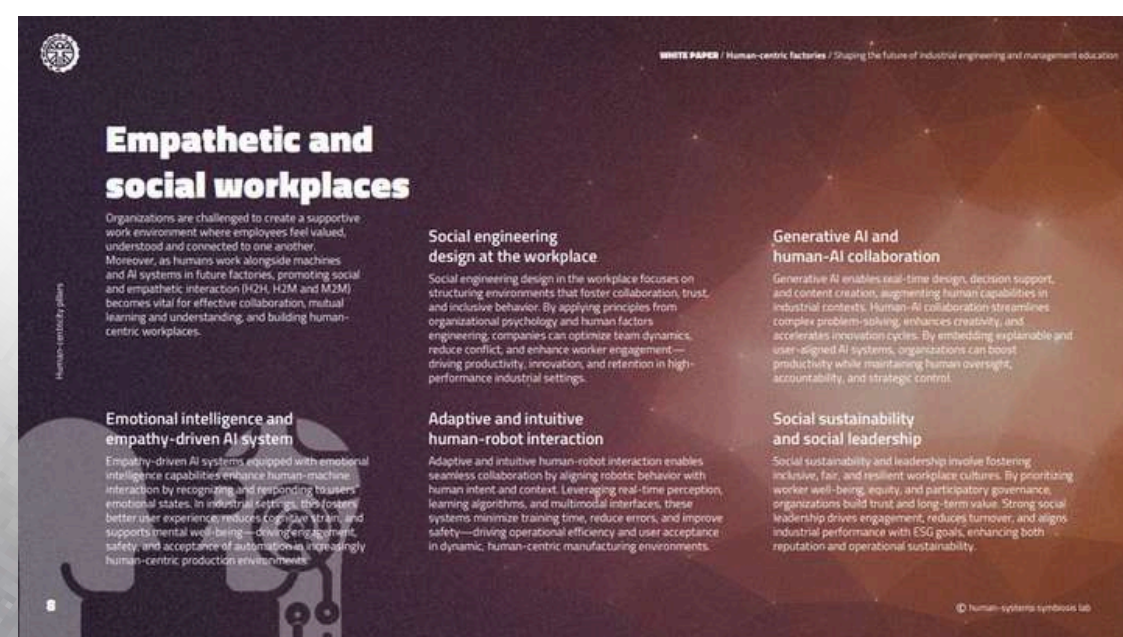
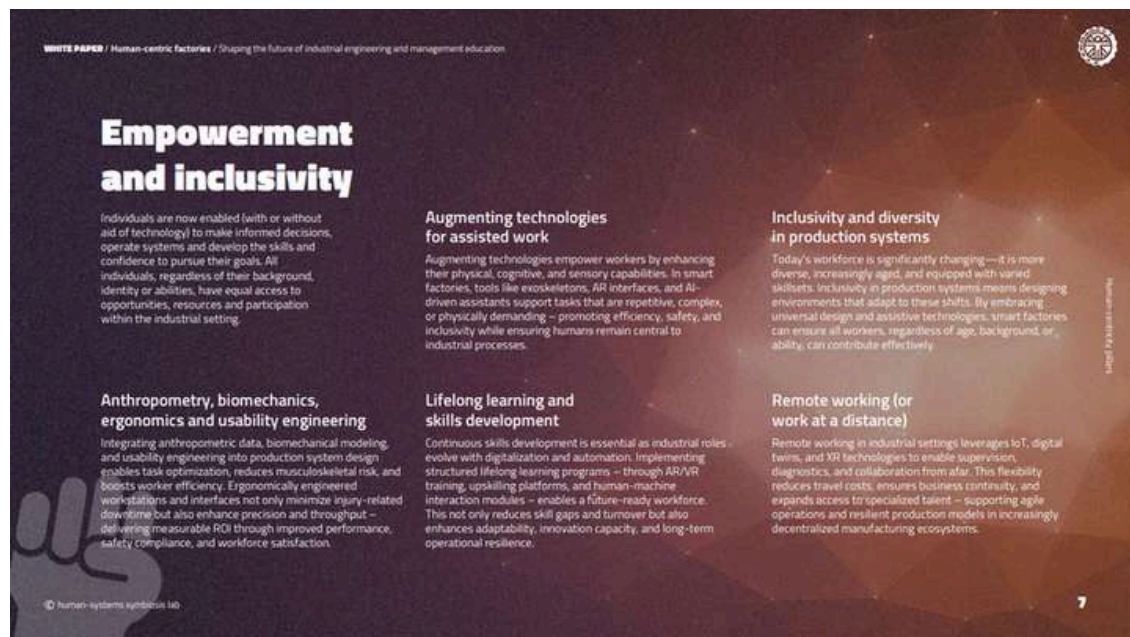
WHITE PAPER / Human-centric factories / Shaping the future of industrial engineering and management education

The industrial world is undergoing a profound metamorphosis. We have moved beyond the era of the factories depicted in Modern Times, where Charlie Chaplin is literally swallowed by the machinery of mass production. And yet, the satirical force of that film remains strikingly relevant. Today's workplaces still raise the same essential question: What is the role of the human being in a world increasingly shaped by automation, artificial intelligence, and digital systems?

This is where the vision of Industry 5.0 marks a paradigm shift. Rather than displacing humans, it calls for a renewed alliance between human intelligence and technological power. Industry 5.0 values not only efficiency and automation, but also creativity, ethics, empathy, and critical thinking – the distinctly human qualities that machines cannot replicate (or not yet).

The engineer of tomorrow must be more than a technical expert. They must be a systems thinker, an ethical decision-maker, and an orchestrator of collaboration – between humans, intelligent machines, and digital platforms. They must be equipped not only to optimize processes, but to understand the broader social and organizational implications of technology, ensuring that innovation serves people, not the other way around.

© human-systems symbiosis lab



Our latest research results



Teaching, education and professional development

University courses

Smart Factories

Master Degree in Management Engineering
University of Calabria

Visit: <https://www.uss-lab.it/smart-factories/>



e-Learning

LEONARDO platform

Access our online resources to know more about Industry 4.0/5.0 and Smart Factories!

Visit: <https://www.uss-lab.it/leonardo/moodle/>



A smart brewing learning and research lab



A regional observatory for digital innovation



PODCAST | I ragazzi della P4.0

20-min episodes hosted by the “Smart Factories” students of the Master Degree course in Management Engineering

14 thematic episodes on digital innovation and industries of the future with **Calabrian companies**



Ascolta il podcast su [Spotify](#) >
oppure direttamente sul sito:
<https://www.uss-lab.it/podcasts/>





UNIVERSITÀ
DELLA
CALABRIA

DIPARTIMENTO DI INGEGNERIA
MECCANICA, ENERGETICA
E GESTIONALE

DIMEG



human systems
symbiosis lab
<https://uss-lab.it>

Contacts

come to say hi

Via Pietro Bucci, Building 45C, Third Floor
Department of Mechanical, Energy and
Management Engineering (DIMEG)
University of Calabria
Arcavacata di Rende (CS) – 87036, Italy

want some info?

Web: <https://www.uss-lab.it>
Email: antonio.padovano@unical.it
Tel. | Ph. +39 0984 494757