

Human-Centric ICT for Industry 5.0

Summer School — University of Pisa

The Summer School “**Human-Centric ICT for Industry 5.0**”, organised within the framework of the **FoReLab project** at the University of Pisa, offers an intensive training programme of **30 hours of lectures and 12 hours of collaborative project work**, dedicated to the evolution of industrial paradigms towards a **human-centric, sustainable, and resilient** model. The school is addressed to PhD students, master’s students, early-career researchers, and professionals interested in exploring the enabling technologies of the transition from Industry 4.0 to Industry 5.0, with a particular focus on the central role of the person — operator, user, or patient — within production and service systems.

Contents and Thematic Areas

The programme covers the main ICT enabling technologies for Industry 5.0 in a cross-disciplinary way, including:

- **Artificial Intelligence and Large Language Models (LLMs)** for industry, with insights into federated learning, explainable AI, and model personalisation;
- **Affective computing and emotional state monitoring**, with a component **strengthened this year by speech signal analysis** for emotion and mood recognition, complementing traditional approaches based on physiological signals (HRV, EEG, EDA);
- **Collaborative robotics, shared autonomy, and haptic interfaces** for human-machine teaming;
- **RFID technologies** for automatic identification, localisation, and sensing, with applications to workplace safety;
- **Augmented and Mixed Reality (AR/MR)** for education and training;
- **5G/6G telecommunications** supporting industrial cyber-physical systems;
- **Assistive technologies and One Health principles** in engineering design;
- **Innovative sensing technologies** for human monitoring.

Hands-on Laboratory Activities

Complementing the theoretical lectures, the Summer School includes **two hands-on practical sessions** that allow participants to directly experience some of the technologies studied:

- **Practical Session #1 — RFID technology for safety applications:** participants will see a real RFID system in operation, exploring the capabilities of UHF passive tags, fixed and portable readers, and RFID sensors for localisation, tracking, and environmental monitoring (temperature, humidity, fill level) in industrial and workplace safety contexts.
- **Practical Session #2 — Partners in Control: Franka Emika Panda Teleoperation Workspace:** a laboratory on *shared autonomy* in which students will implement an operator-assistance function for the teleoperation of a **Franka Emika Panda robot** performing pick-and-place tasks. The system, based on ROS within a Docker environment, uses **webcam-based hand tracking** as the primary input, providing a concrete real-time experience of human-robot collaboration.

Project Work: Applying Human-Centric ICT in Real-World Scenarios

An integral and distinctive component of the school is the **collaborative project work** entitled “*From technology to strategy: designing human-centric innovation*”. Participants, organised into **multidisciplinary “company innovation task forces” of 4–5 people**, take on specific managerial roles — CTO, COO, Sustainability & Compliance Manager, HR & Change Manager, CEO/Strategy Lead —

and are asked to analyse **realistic industrial scenarios** (traditional food manufacturing, Tier 2 automotive, public healthcare, sustainable logistics) in order to design innovative solutions based on the technologies presented during the week.

The pathway is structured in four phases: **context analysis**, **technology selection**, **design of an implementation roadmap**, and a **final pitch** before the faculty. This approach enables participants to integrate technical competences with a strategic perspective, simultaneously considering technological feasibility, return on investment, ESG impact, and workforce acceptance.

Contribution from Industry

A distinctive feature of the school is the **active participation of industry representatives**, who join the academic faculty bringing first-hand testimonies from the field. Contributions include, among others, **Baker Hughes** on systems engineering as a practice for designing human-in-the-loop strategies, and **Linfa Digitale S.r.l.** on the state of the art of Industry 4.0 and the challenges of Industry 5.0 adoption. This cross-fertilisation between academic research and industrial experience offers participants a concrete perspective on how human-centric technologies are actually implemented in real production contexts.

Learning Outcomes

By the end of the school, participants will have acquired an **integrated and up-to-date overview** of the ICT technologies enabling the transition to Industry 5.0, together with cross-disciplinary competences ranging from the design of human-in-the-loop systems to the analysis of the socio-organisational impact of technological innovations, and the ability to translate technological opportunities into concrete, sustainable business strategies.

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Pisa, 22-27 June 2026

Venue: Aula Magna Pacinotti - Scuola di Ingegneria
Largo Lucio Lazzarino, 1, 56126 Pisa PI, Italia

Monday 22	Morning	Afternoon
	Intro HCS for I5.0 (Prof. Nicola Vanello) 9:00-9:30 am	Systems engineering as practice to design human-in-the-loop strategies: the Baker Hughes experience (Dr. Gregorio Vettori – Baker-Huges) 2:00-4:00 pm
	University role in 5.0 paradigm shift – the FoReLab project (Prof. Giovanni Stea) 9:30-10:30 am	Assistive technologies (Prof. Luca Fanucci) 4:00-6:00 pm
	State of the art 4.0 and/or Challenges for 5.0 implementation (Dr. Lorna Vatta, Executive Linfa Digitale S.r.l.) 10:30-12:30 am	<i>Social Event 6:00-9:00 pm</i>
Tuesday 23	Morning	Afternoon
	Human monitoring: new approaches to Sensor Fabrication and design (Prof. Giuseppe Barillaro) 9:00-11:00am	RFID technology for localization and sensing (Prof. Alice Buffi) 2:00-4:00pm
	The Transformation of Telecommunications to Support Industry 5.0 (Prof. Stefano Giordano) 11:00am–1:00pm	Practical Session #1: RFID technology for safety applications (Prof. Paolo Nepa) 4:00-6:00pm
Wednesday 24	Morning	Afternoon
	Partners in Control: Exploring Human-Machine Teaming (Prof. Andrea Munafò) 9:00-11:00am	Group Work #1 - project definition (Prof. Riccardo Costanzi & Prof. Nicola Vanello) 2:00-4:00pm
	Practical session #2: Collaborative Robots (Prof. Andrea Munafò) 11:00am-1:00pm	Models of emotions and estimation from physiological signals (Prof. Mimma Nardelli) 4:00-6:00pm
		<i>Social Dinner: 8 pm →</i>
Thursday 25	Morning	Afternoon
	LLMs for Industry 5.0 (Prof. Nicola Tonellotto) 9:00-11:00pm	Technologies for affective state monitoring (Prof. Enzo Pasquale Scilingo) 2:00-4:00am
	One Health Principles in Engineering design (Prof. Arti Ahluwalia) 11:00am-1:00pm	AR&MR applications for education and training (Prof. Sara Condino) 4:00-6:00pm
Friday 26	Federated learning and model personalization (Prof. Alessio Bechini) 9:00 am-11:00 pm	Group Work #2 - project creation (Dr. Lorna Vatta) 2:00-6:00pm
	Human-in the loop - robotic systems and haptic interfaces (Prof. Matteo Bianchi) 11:00 am-1:00 pm	
Saturday 27	Speech analysis for emotion and mood recognition (Prof. Nicola Vanello) 9:00 am -11:00 pm	
	Project Finalization and Presentations (Prof. Nicola Vanello) 11:00 am -1:00 pm	