CIRCULAR AND SUSTAINABLE MADE IN ITALY PHYGITAL PATHWAYS FOR SOCIAL INNOVATION

Motivation

The transition of the Made in Italy sectors towards circular and sustainable models necessitates the integration of digital technologies with traditional manufacturing processes. This integration aims to develop production systems that are self-sufficient, self-regenerative, reliable, safe, and sustainable. Phygital approaches—combining physical and digital elements—enable the creation of innovative solutions that address social challenges through engineering methodologies. The session focuses on exploring engineering strategies, tools, and interdisciplinary approaches that support circular innovation across product-service systems, contributing to social development and territorial resilience.

Background

Recent advancements in digital technologies, such as the Internet of Things (IoT), Artificial Intelligence (AI), Digital Twins (DTs), and Additive Manufacturing (AM), have opened new possibilities for implementing circular economy principles in the Made in Italy sectors, including fashion, furniture, and automation. These enabling technologies support the transition toward sustainable value chains by enhancing real-time data acquisition, product lifecycle traceability, predictive maintenance, and resource efficiency. The integration of digital tools with traditional manufacturing processes facilitates the development of phyigital systems, which merge physical and digital domains to support environmentally and socially responsible innovation. Models, methods, and tools are required to design, simulate, and validate these integrated systems in alignment with sustainability and circularity objectives.

The session invites original contributions on theoretical, methodological, and experimental advancements in the following areas (but not limited to):

- Design and engineering of product-service systems
- Lifecycle assessment and sustainability metrics for circular manufacturing
- Integration of IoT and AI for monitoring and optimizing value chains
- Development of digital platforms for collaborative design and stakeholder engagement
- Additive Manufacturing techniques for sustainable production and remanufacturing
- Engineering methods for social impact assessment in product development
- Digital twins for predictive maintenance and resource optimization
- Virtual Prototyping and simulation environments for circular design validation
- Model-based System Engineering for sustainable and resilient system design
- XR-based approach for energy monitoring, user training, and immersive evaluation
- Development of sustainable materials and processes for circular applications
- Human-centered design approaches for inclusive and sustainable innovation

The Special Session proposers include:

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Structure of the session

Invited speaker:
PoliTo, UNIBS, Technical University of Chemnitz, Technical University of Dresden, Fraunhofer IWU, Camozzi
Oral presentations
To discuss.