

## Enhancing the Circular Economy Transition Socio-Economically: Human-Centric Technology Integration in the Industry 5.0 Era

As global industries shift towards incorporating more sustainable practices, the need for models that integrate the economic, environmental, social and technological aspects stands as a critical success factor for the effective adoption of circular economy (CE) models. On the one hand, the CE has emerged as a promising approach to address these challenges by promoting resource efficiency, waste reduction, and economic decoupling from environmental degradation. However, many existing CE models have focused primarily on economic and environmental dimensions, often overlooking the critical role that humans play in promoting and maintaining sustainable ecosystems. On the other hand, the Industry 4.0 paradigm, with its emphasis on digital transformation and automation, has laid the groundwork for more efficient, interconnected systems that enable greater resource utilization and cost savings (Atif 2023). Moreover, the Industry 5.0 paradigm emerges as an extension to Industry 4.0, focusing on the integration of human creativity and collaboration with intelligent systems to ensure that economic progress is not only efficient, but also sustainable and regenerative (Nahavandi 2019).

This special session is a direct response to the European Commission's (2022) call for academics to engage in interdisciplinary research that promotes new business models, industrial ecosystems, and value chains based on the principles of circularity, regeneration, and sustainability. As highlighted in the European Commission's (2022) vision for the Industry 5.0 paradigm, this research should not be limited to technological advances, but must also consider socio-economic impacts, with a focus on circularity, resilience and environmental responsibility. This session will address these goals by placing humans at the center of circular loops and exploring how advanced technologies such as AI, IoT, blockchain, and robotics can revolutionize circular systems while promoting human skills and participation.

We invite academics, industry experts and policy makers to submit papers that explore the technological, economic and social dimensions of this shift. Topics may include digital platforms for circular supply chains, the use of technology in waste management, or policy frameworks for promoting equitable CEs. Papers that combine theory with practical case studies are encouraged, as we seek to create an inclusive dialogue on the future of circular systems in the context of Industry 5.0. Suggested topics for collaboration include, but are not limited to, the following:

- Technology-driven, human-centered design of CE models
- Social equity and inclusion in CE policies
- Human-machine interaction/collaboration for circular systems using IoT, AR, etc.
- Reduced human interaction/involvement through technologies such as generative AI
- Responsible circular sourcing through Industry 4.0/5.0 technologies
- Blockchain-enabled CE communities/reward systems and social accountability
- Digital twinning and simulation of human interaction with circular systems
- Robotics to support human work in recycling, sorting or waste management
- Data-driven predictive maintenance in circular supply chains
- Circularity in additive/3D printing manufacturing
- Sustainability metrics for CE initiatives
- Extended reality (XR) for CE education and training

### References

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- Nahavandi, S. (2019). Industry 5.0—A human-centric solution. *Sustainability*, 11(16), 4371.

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