THE ROLE OF CIRCULAR ECONOMY IN INDUSTRY 5.0

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Background

In order to reduce the manufacturing industry's contribution to emissions, the European Commission has presented the Industry Plan for the Green Deal. The concept of Industry 5.0 and the Circular Economy Strategy have also been taken into account as key drivers in the transformation to a green continent. Industry 5.0 (I5.0) is presented as an industrial (value-driven) revolution, which, in addition to new technologies, aims to apply the technologies of the Fourth Industrial Revolution to a wider range of applications. The circular economy as a regenerative economic model is therefore also a pillar of I5.0. Austria is implementing EU plans at national level, including the circular economy plan.

Method

A systematic literature review was conducted to answer the research questions:

- *Can the concept of circular economy contribute to the realization of Industry 5.0 in manufacturing companies, and if so, with which technologies, and what is the technological impact on CE?*
- *What are the (expected) barriers and enablers for the implementation of the technologies?*

Search in Scopus and Web of Science using the keywords Industry 5.0 AND circular economy AND manufacturing. Articles remaining for analysis after title and abstract screening (n=47), of which nine articles (n=9) referred directly to the link between Industry 5.0 technologies and the circular economy. 38 articles analyzed this in the broader overall context.

Research Question 1

Of the 101 technologies identified, a large proportion are already part of the fourth industrial revolution (e.g. IoT, AI, big data). The value-driven approach of I5.0 envisages an expanded role for them.

- Development of reverse logistics
- Digital circular economy
- Predictive analytics
- Increasing resilience

The most frequently mentioned expected effects on CE.

- Artificial Intelligence (AI)
- Machine learning (ML)
- Big Data
- Blockchain
- Internet of Things (IoT)
- Industrial (green) IoT
- Edge computing
- Cloud computing
- Digital Twin (DT)
- Cognitive DT
- Augmented Reality
- Virtual Reality
- Cyber-physical systems
- RFID
- Biotechnologies

The most frequently mentioned technologies.

Research Question 2

Enablers

- Staff training
- Tax incentives
- Green finance
- Management support
- Clear metrics and indicators
- Legal framework
- Public awareness
- Standards
- Strategic partnerships
- Government incentives
- High level of automation

Barriers

- Costs
- Lack of regulation and standards
- Lack of laws
- Lack of resources → financial, technical, human
- Social barriers
- Data privacy
- Regulatory barriers
- Job insecurity
- Cyber security
- Ethical issues
- KPI standardisation
- Political barriers

The most frequently mentioned enablers and barriers in the papers analyzed. In total, 103 enablers and 160 barriers were identified (multiple responses counted).

Limitations

Since the term Industry 5.0 was coined, only a few studies have been carried out, which shows that neither the term nor the concept of I5.0 has yet arrived in industry.

Outlook

Further research will be needed to determine the impact of Industry 5.0 technologies on CE and, most importantly, to establish a suitable metric.

Disclaimer: Picture made with AI tool leonardo.

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