In order to create a globally sustainable steel industry, circular business models to reuse residual energy and resources from energy-intensive production are essential. Additionally, Europe needs to maintain a leading position in sustainability to preserve the global competitiveness of the European steel industry. Industrial symbiosis is a key enabler, allowing for more circular resource flows and better utilisation of industrial by-products. Furthermore, the EU and scholars have identified digitalization, especially AI, as a powerful enabler for a circular economy (e.g., [1], [2], or [3]). Nevertheless, there is a lack of studies examining how AI innovation can be used to create or improve existing industrial symbioses.

Purpose – Our thesis aimed to explore and provide empirical insights into AI-driven circular business model innovation (CBMI) in industrial symbiosis. In doing so, it addresses the knowledge gap regarding how industrial companies can use AI to amplify circular business models and facilitate AI-driven circular innovation. Research questions:

RQ1: How can Artificial Intelligence amplify the circularity of an industrial symbiosis?
RQ2: How can Artificial-Intelligence-driven Circular Business Model Innovation be facilitated in an industrial symbiosis?

Method – The research questions were addressed through a case study of an ongoing AI innovation initiative in SSAB's industrial symbiosis in Luleå, consisting of SSAB, LuleKraft and Luleå Energi. The goal of the symbiosis is to use residual gases from SSAB's steel production for electricity and district heating production. We conducted two analyses:

1. Concentrated on RQ1 and included a thematic analysis and Monte Carlo simulation.
2. Focused on RQ2 and consisted of a thematic analysis.

The analyses were based on: 32 interviews with informants from the companies participating in the innovation initiative and external experts; two site visits; four project meetings; and 61 secondary sources.

Findings – The analysis showed how AI can amplify an industrial symbiosis and uncovered three principles and symbiotic facilitators for AI-driven CBMI. The principles and symbiotic facilitators were combined in a coevolutionary alignment framework for AI-driven CBMI in industrial symbioses.

Theoretical contributions – This study contributes to prior literature by

1. depicting how AI changes business models and amplifies an industrial symbiosis, where past research only had conceptualised it
2. identifying principles that describe how AI-driven CBMI should be approached
3. uncovering symbiotic facilitators that create conditions for successful AI-driven CBMI
4. conceptualising a coevolutionary framework based on the principles and symbiotic facilitators for aligning the innovation efforts between partners in industrial symbioses.

Practical implications – Managers can use this study to comprehend how AI can improve resource flows and the significance of efficient data management and sharing in collaborative AI innovation. Moreover, it provides a framework to assist companies in aligning AI innovation initiatives among partners. The framework clarifies how interconnected factors are that facilitate innovation in partnership, which can help in designing business model innovation activities. By applying these insights industrial symbioses can foster collaborative innovation and leverage AI for positive circular economy outcomes.

In addition to illustrating how AI innovation can be facilitated and used for sustainability purposes (through a real-world example), we believe the thesis can inspire other steel companies to invest in AI. In turn, this can lead to more circular resource flows and enhanced competitiveness of the European steel industry.

References

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