

Exploring the Potential of Smart Packaging in Circular Economy Strategies

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Abstract

This study explores the potential of Smart Packaging (SP) to enhance logistics capabilities within Circular Economy (CE) frameworks, suggesting how SP might help facilitate sustainable and responsible industry practices. We discuss the possibilities offered by integrating intelligent, active, and connected packaging solutions that go beyond traditional containment and protection packaging functions to enable proactive, real-time coordination of demand, supply, and information flow across sectors.

Through a systematic literature review of 46 peer-reviewed articles, selected from an initial dataset of 1586 entries, we propose a conceptual model that illustrates the interaction between SP functionalities and logistics capabilities, highlighting their impact on CE strategies. The study employs the PEO (Population, Exposure, Outcome) framework to identify relevant studies and uses study context coding to assess SP's alignment with logistic capabilities and its application to CE.

Our review suggests that integrating SP could be instrumental in enhancing the circularity of supply chains, potentially leading to more resilient trade networks. SP functionalities enhance logistics performance by enabling agile, data-driven decision-making. By improving real-time data exchange, predictive analytics, and automated inventory management, SP fosters more responsive supply chains and supports the transition to circular models. The study highlights the need for stakeholder collaboration, emphasizing coordinated efforts among manufacturers, logistics providers, policymakers, and consumers to maximize SP's benefits for long-term CE goals.

The study indicates that SP could support societal benefits by encouraging sustainable consumption, reducing waste, and improving recycling processes crucial for circular supply chains. The adoption of SP might optimize resource efficiency and offer environmental benefits, aligning with sustainability goals. Furthermore, the potential societal impacts of SP include supporting sustainable economic models through better resource management and waste reduction, promoting environmental stewardship, and enhancing corporate social responsibility. SP is also shown to improve transparency and consumer trust by ensuring precise and reliable product management throughout its lifecycle.

We recognize the need for continued interdisciplinary research and collaborative efforts to fully understand and leverage SP's capabilities in supporting CE goals. This study underscores SP's role in bridging technological innovation with societal needs, emphasizing the importance of rigorous technology assessment in driving sustainable development.

Keywords

Smart packaging, Circular economy, Logistic capabilities, Supply chain management

Current status of the research is: Work-in-progress