

Sustainable Business Model Innovation: The Role of Circular Economy Principles in the Digital Age

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Abstract—The accelerating pace of digital transformation is reshaping how organizations conceptualize and implement sustainability within their business models. This study explores how circular economy (CE) principles—such as resource efficiency, product longevity, and waste valorization—can be embedded into digital business model innovation (BMI) to foster economic resilience and environmental stewardship. Through an integrative framework combining digital technologies (AI, IoT, blockchain) with CE strategies, the research investigates how firms transition from linear value creation to regenerative, data-driven ecosystems. The study also highlights the enabling role of digitalization in material tracking, predictive maintenance, and closed-loop supply chains, emphasizing its potential to decouple growth from resource depletion. Findings suggest that sustainable business model innovation in the digital era requires not only technological adaptation but also organizational learning, stakeholder collaboration, and systemic thinking.

■ Sustainability has emerged as a defining principle of 21st-century business strategy, driven by mounting environmental pressures, shifting consumer expectations, and tightening global regulations [3]. As industries transition toward Industry 4.0, the convergence of digital technologies and sustainability imperatives is reshaping traditional approaches to value creation. Within this evolving landscape, sustainable business model innovation (BMI)—the reconfiguration of business logic to create economic, social, and environmental value simultaneously—has become a critical mechanism for achieving long-term competitiveness [8]. A particularly powerful pathway to sustainable BMI lies in the adoption of circular economy (CE) principles, which promote closed-loop systems where products, materials, and energy are

continuously reused, repurposed, or regenerated.

The integration of circular economy concepts into business models is increasingly enabled by digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and blockchain. These technologies facilitate the real-time monitoring of product lifecycles, predictive maintenance, material traceability, and reverse logistics, thereby strengthening the operational viability of circular systems [7]. For instance, IoT-enabled sensors can track component performance, allowing companies to design for durability and optimize product reuse, while blockchain can provide transparent, tamper-proof records that ensure accountability throughout the supply chain. Together, these innovations help firms shift from traditional ownership-based models to “product-as-a-service” systems that emphasize longevity and shared value [2].

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