

The Role of ERP Systems in Supporting the Transition to a Circular Economy

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Abstract. The introduction of Enterprise Resource Planning (ERP) systems is becoming crucial in facilitating the transition to a circular economy. These systems enable the integration and optimization of business processes, leading to more efficient resource management. The circular economy focuses on minimizing waste and extending the life cycle of products, which requires transparency, traceability, and real-time data, capabilities that ERP systems provide. This paper aims to outline the key roles that ERP systems play in supporting the transition to a circular economy, emphasizing how integrated information systems contribute to sustainability and improve operational efficiency. By analyzing the main functionalities of ERP systems, this paper explores how these systems facilitate better planning, control, and reporting in alignment with the principles of the circularity.

Keywords: ERP system, circular economy, transition.

1. Introduction

Unlike traditional linear production and consumption models that advocate a take-use-dispose approach, the circular economy (CE) focuses on extending the life cycle of products by emphasizing reducing waste, reusing resources, and repairing. CE can be described as the system that is restorative or regenerative concept which includes restoration, shifts towards the use of renewable energy, and elimination the use of toxic chemicals. This concept aims to eliminate the waste through the well design of materials, products, systems, and new business models (Ellen MacArthur Foundation, 2013).

Companies play a crucial role in implementing CE since their business models and practices directly impact resource consumption and waste generation. In business context, digital technologies are recognized as one of the main drivers of facilitating CE practices (Rizvi et al., 2021). Such technologies include electronic tools and management information systems that generate, process, store and share informations among different departments (Wynn & Jones, 2022). Some academicians (Kottmeyer,

2021; Neri et al., 2023) believe that digital technologies such as Enterprise Resource Planning (ERP) systems can contribute to overcoming the gap between CE theory and practices making implications both for the nature resources and human prosperity. ERP in this case emerges as a key digital transformation tool that enables companies to adopt circular practices. The ERP systems are an information based computer-technology systems that enables integration of all the main business functions of the company into one application with a unique database (Wagner & Monk, 2008). The study by Cagno et al. (2021) recognised ERP as base technology for CE practices realization. The study by Payer et al. (2024) stated that ERP can ensure the authenticity of circularity reports providing transparency for stakeholders, track of raw materials origin and monitoring the suppliers adherence to sustainability in supply chains. Additionally, ERP provides reduction of inputs and supervision of the productivity and efficiency in material use.

Nevertheless, Acerbi et al. (2021) has pointed out that, although advances in materials and energy management are visible, "information management and data exchange" still remain a major challenge in implementing CE strategies. Therefore, this paper aims to outline the essential roles that ERP systems, as digital information system, play in facilitating the transition to a circular economy. The paper examines in detail, with reference to concrete examples, how ERP systems facilitate the practical implementation of the principles of Reduce, Reuse, and Repair within the circular economy.

2. Background on ERP Systems Support to the Circular Economy

The role of ERP systems is increasingly important in promoting the circular economy. In this context, ERP serves as valuable tool that encompasses process optimization, waste reduction and boost of the management decisions aligned with CE goals. Roles of ERP systems in transition to CE can be recognised through various ways through Reduce, Reuse and Repair.

In the context of Reduce, ERP systems support waste management reporting as one of the main requirements of CE in business, providing actionable insights based on waste generation tracking (Widiyanto et al., 2024). Therefore, ERP systems can contribute to waste reduction. ERP solutions offer powerful analytic tools with reliable real-time metrics regarding energy consumption and eco-footprint. In this regard, ERP can create reports on energy consumption in production process that initiate steps to energy usage reduction. One of the ERP system contributions to CE transition is in resource optimization (Alzahmi et al., 2025). ERP analytics can ensure real-time materials tracking and ensure resources usage efficiency. For example, ERP monitoring options can identify overused materials in the production process and signalized it to the operators. In addition, this kind of notification implicate organization managers to make strategic data-driven decision to support the CE implementation. Additionally, integrated with Advanced Planning and Scheduling tools, ERP enables grouping of production batches to minimize waste and material consumption (Vieira et al., 2021).

Furthermore, in terms of Reuse, supply chains focused on recovery, refurbishment and redistribution can facilitate CE practices in industry. For instance, ERP enabled closed-loop supply chains offer the flow of the used materials and products backed into the process. With this strenght, ERP highlights reusing and recycling. Additionally in this light, ERP enables monitoring the entire lifecycle from design to reuse of the product, highlighting the extention of product usage as long as possible.

When it comes to Repair, ERP solutions help facilitating the collaboration across circular ecosystems as CE emphasizes the interconnection of suppliers, consumers and companies. For instance, manufacturer can use ERP to communicate with supplier to order recycled material or to communicate with customer about repairing the used product. ERP can integrate product-as-a-service models, where products are maintained or repaired throughout their life cycle, rather than being thrown away.

3. Conclusions

In this paper, the key role of the ERP system in supporting the transition from the traditional linear production model to the principles of the circular economy is clearly highlighted. ERP systems enable the integration and optimization of business processes, providing transparency, monitoring, and real-time analytics, which directly contribute to achieving CE. In particular, through the principles of Reduce, Reuse, and Repair, ERP systems enable the reduction of waste and resource consumption, the monitoring and reuse of products, as well as the coordination of repairs and maintenance throughout the entire product life cycle. Thus, ERP functions as a central tool that connects all actors in the value chain, from suppliers to consumers, facilitating the implementation of sustainable business models and increasing operational efficiency. This paper highlights that ERP systems function not only as essential technical support tools but also as strategic instruments that drive business transformation. This transition involves rethinking resource utilization, minimizing waste, and promoting

long-term environmental stewardship, towards a more sustainable and circular economy.

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References

- Acerbi F., Sassanelli C., Terzi S. and Taisch M. (2021), A systematic literature review on data and information required for circular manufacturing strategies adoption, *Sustainability*, **13**(4), 2047.
- Alzahmi W., Al-Assaf K., Alshaikh R. and Bahroun Z. (2025), Towards Sustainable ERP Systems: Emerging Trends, Challenges, and Future Pathways, *Management Systems in Production Engineering*, **33**(1), 24-38.
- Cagno E., Neri A., Negri M., Bassani C.A. and Lampertico T. (2021), The role of digital technologies in operationalizing the circular economy transition: A systematic literature review, *Applied Sciences*, **11**(8), 3328.
- Ellen MacArthur Foundation. (2013), Towards the circular economy: An economic and business rationale for an accelerated transition, *Ellen MacArthur Foundation*.
- Kottmeyer B. (2021), Digitisation and sustainable development: The opportunities and risks of using digital technologies for the implementation of a circular economy, *Journal of Entrepreneurship and Innovation in Emerging Economies*, **7**(1), 17-23.
- Neri A., Negri M., Cagno E., Kumar V. and Garza-Reyes J.A. (2023), What digital-enabled dynamic capabilities support the circular economy? A multiple case study approach, *Business Strategy and the Environment*, **32**(7), 5083-5101.
- Rizvi S.W.H., Agrawal S. and Murtaza Q. (2021), Circular economy under the impact of IT tools: A content-based review, *International Journal of Sustainable Engineering*, **14**(2), 87-97.
- Vieira J., Deschamps F. and Valle P.D. (2021), Advanced planning and scheduling (APS) systems: a systematic literature review, *Transdisciplinary Engineering for Resilience: Responding to System Disruptions*, **16**, 385-394.
- Wagner B. and Monk E. (2008), Enterprise resource planning, Course Technology Press.
- Widiyanto E.P.E.A., Ridwan A.Y. and Hediyanto U.Y.K.S. (2024, September), Development of waste management system based on open-source ERP to support the circular economy, *AIP Conference Proceedings*, **3115**(1), 040007.
- Wynn M. and Jones P. (2022), Digital technology deployment and the circular economy, *Sustainability*, **14**(15), 9077.