

# Chapter 8

## From Transparency to Circularity: Enhancing Supply Chain Sustainability Through Big Data

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### ABSTRACT

*Global supply chains are under increasing scrutiny to address environmental, social, and governance (ESG) challenges while maintaining competitiveness and resilience. Big data has emerged as a transformative tool that not only improves transparency but also enables the transition towards circular economy models. This chapter investigates how big data analytics can support the shift from linear practices to circular supply chains that prioritise resource efficiency, waste reduction, and product life-cycle optimisation. It examines the role of big data in enhancing supply chain visibility, enabling predictive decision-making, and fostering collaboration across stakeholders. Case examples will demonstrate how industries such as food, apparel, and manufacturing are using big data to achieve traceability, reduce carbon footprints, and enable closed-loop systems. The chapter will also critically discuss barriers, including governance, interoperability, and ethical concerns, while offering a practical framework for integrating big data into circular supply chain strategies.*

### OVERVIEW

Global supply chains are increasingly confronted with complex sustainability challenges arising from climate change, resource scarcity, regulatory pressures, and

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heightened stakeholder expectations. Traditional linear models based on extraction, production, consumption, and disposal exacerbate environmental degradation and social inequalities across the supply chain network (Geissdoerfer et al., 2017). Key issues include excessive carbon emissions, poor labour practices, waste generation, and inefficiencies in resource utilisation. These challenges highlight the urgent need for innovative approaches that can balance economic growth with environmental and social responsibility (Seuring & Müller, 2008).

To address these challenges, there is a growing call to move beyond mere transparency in supply chains, which focuses on visibility, traceability, and disclosure of practices, towards circularity, which seeks to redesign systems to eliminate waste and enable closed-loop processes (Ellen MacArthur Foundation, 2019). Transparency is a necessary first step, as it provides visibility into supplier practices and product lifecycles, yet it does not by itself drive systemic change. Circular supply chains, by contrast, embed sustainability into the entire value network by promoting reuse, remanufacturing, recycling, and resource efficiency, thereby reducing dependency on finite resources (Sibanda et al., 2025).

Big data emerges as a powerful enabler in this transition from transparency to circularity. The proliferation of digital technologies such as the Internet of Things (IoT), blockchain, and predictive analytics allows firms to collect, integrate, and analyse vast datasets across their global networks. These data-driven insights improve visibility, support real-time decision-making, and enable proactive management of sustainability risks and opportunities (Wamba et al., 2017). For instance, big data applications can track material flows, optimise logistics to reduce emissions, and forecast demand to minimise overproduction and waste. In this way, big data analytics not only enhances supply chain transparency but also provides the foundation for implementing circular economy principles at scale.

The chapter builds on these arguments by exploring how big data can be harnessed to address sustainability challenges in global supply chains, facilitate the transition from transparency to circularity, and provide actionable frameworks for both academics and practitioners. The next section focuses on the conceptual framework.

## **CONCEPTUAL FRAMEWORK**

The proposed conceptual framework, *Transparency to Circularity Through Big Data*, delineates the mechanisms through which Big Data technologies enable the evolution of supply chains from transparency-oriented operations to fully circular systems. In the context of sustainable supply chain management, transparency defined by the extent to which firms can trace, monitor, and disclose material and information flows is a foundational prerequisite for circularity. By leveraging Big Data tools such

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