


# Chapter 6

## Impact of Emerging Technologies on Supply Chain Efficiency and Sustainability

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### **ABSTRACT**

*New technologies like AI, IoT, blockchain, and big data analytics are transforming supply chains to be more efficient, visible, and sustainable. Each individual technology has been helpful on its own, but the combined opportunities and implications of these technologies have not been fully uncovered to date, particularly in complex, fragmented, or other developing market contexts. This research aims to assess how the convergence of these technologies impact the performance of supply chain systems when examined from a sustainability perspective. By integrating real world case studies with academic knowledge, the research reveals challenges and handrails along with opportunity to apply best practices. The findings indicate that intentional technology design, combined with stakeholder collaboration, are fundamental components of creating sustainable value. This research builds theoretical contributions for the literature and provides practical guidance for those who are engaged in the challenge of digitally transforming their supply chains.*

DOI: 10.4018/979-8-3373-3790-6.ch006

## 1. INTRODUCTION

The global context of supply chains has changed dramatically as new digital technologies are changing the ways we think about supply chains. Organizations are in a greater struggle to pursue efficiencies while adhering to the increasing demands for sustainability and ethical governance. Technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, and big data analytics are being rapidly adopted rethinking supply chain models that once relied on highly manual processes between siloed systems.

The traditional supply chain was mainly based on speed, cost, and responsiveness. Today, the sustainability agenda, driven by climate change, social expectation, and regulatory processes, has changed what it means to be efficient in modern supply networks. Because of this, efficiency no longer equates to speed or saving money, it now means being resilient, visible, traceable, and optimizing resources (Kumar et al., 2022). This paradigm shift is a result of digital transformation, which allows for supply chains to act as ecosystems that are adaptive, transparent, and circular.

AI applications such as demand forecasting and intelligent routing are contributing to supply chains' ability to make real-time decisions based on dynamic variables that have the potential to mitigate overproduction, stock-outs and last minute shipment delays. Similar to these AI applications, IoT-enabled sensors create hyper-visibility in the status and movement of goods, from raw material sourcing through to delivery to end consumers. Blockchain supports the authenticity of products and safeguards transactions in a decentralized manner, providing transparency, and trust along supply chains while reducing the scope for fraudulent representations. Big data analytics, on the other hand, allows companies to process and analyze the vast volumes of data coming from many different sources with big data algorithms that uncover inefficiencies and environmental risks invisible using previous analytical methods (Singh & Trivedi, 2021).

Even with the examples above of both technologies outcomes within supply chains, most of the academic and industry research on these technologies have been considered in isolation. There is a clear gap around the combined or integrated impact of the technologies involved in both supply chain performance and sustainability. The uptake of one singular technology alone does not encompass what the systemic change businesses in the real world are demonstrating. Supply chains exemplify complex adaptive systems. Accordingly, development and linkages within hybrid systems of technology with the layers of technologies involved; such as AI interpreting IoT information or blockchain storing BDA results potentially create efficiencies that are non-linear given the limitations of old empirical or theoretical models (Chong et al, 2021).

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