Chapter 5
Intelligent Supply Chains and Logistics in the Era of Digital Twins

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ABSTRACT

Digital twins are transforming supply chains into intelligent, adaptive networks capable of real-time visibility, optimization, and predictive decision-making. By synchronizing virtual replicas with IoT sensors, enterprise systems, and logistics infrastructures, digital twins generate continuously updated models that reveal bottlenecks, forecast demand fluctuations, and simulate operational scenarios with high precision. AI-driven analytics enhance these capabilities by supporting

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autonomous routing, adaptive inventory control, and disruption response across global logistics chains. For consumers, digital twins provide transparent tracking, personalized delivery options, and seamless integration with emerging metaverse commerce ecosystems. As organizations pursue greater resilience and sustainability, the fusion of digital twins, automation, and immersive analytics is redefining logistics management and enabling supply chains that learn, evolve, and respond dynamically to changing market and environmental conditions.

INTRODUCTION

1. Global Trends and Consumer Demands

In today's rapidly shifting global business environment, transforming the supply chain is no longer optional but has become a strategic necessity. The post-pandemic landscape and ongoing geopolitical uncertainties have reinforced the importance of resilience, transparency, and adaptability as fundamental pillars in modern logistics strategies. At the same time, consumers now expect supply chains to function not merely as channels for moving products, but as integrated experiences that offer real-time visibility, personalized services, and sustainable value (Gupta et al., 2025).

The rapid expansion of e-commerce and the widespread adoption of digital technologies have heightened these expectations even further. Consumers increasingly demand faster delivery, complete process transparency, and the ability to customize the services they receive. They also want to be more actively involved in the ordering and fulfillment process, including receiving real-time updates and enjoying a seamless, engaging experience from purchase to delivery. These shifting expectations have placed significant pressure on traditional logistics systems, which often struggle to respond quickly and consistently under such demands (Singh et al., 2025).

2. Traditional Supply Chain Limitations

Conventional supply chain systems are generally built for cost efficiency and large-scale distribution under relatively stable demand conditions. However, these systems are often fragmented and lack the responsiveness needed to handle the rapidly changing expectations of modern consumers. When the COVID-19 pandemic struck, many companies were caught off guard as their supply chains collapsed due to material shortages, logistical delays, and the absence of real-time information flow. The pandemic ultimately became a major catalyst that accelerated the digitalization and redesign of global logistics models, pushing organizations toward more flexible and technology-driven approaches .