Chapter 4
The Role and Impact of Artificial Intelligence in Logistics 5.0

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ABSTRACT

Logistics 5.0 represents a new era in supply chain management that integrates technological performance with human-centric values, sustainability, and resilience. This chapter examines the transformative role of Artificial Intelligence (AI) in enabling this transition. It explores how machine learning, computer vision, robotics, and conversational systems enhance forecasting, inventory optimisation, transport, and decision-making processes. The chapter also highlights the organisational and human enablers required for AI adoption, such as strategic alignment, digital infrastructure, workforce readiness, and collaborative ecosystems. Beyond technical innovation, it addresses critical barriers, including data quality, ethical concerns, and regulatory uncertainties. AI in Logistics 5.0 is not merely a tool for automation—it is a strategic lever to build adaptive, inclusive, and intelligent logistics systems. By combining human expertise with artificial intelligence, Logistics 5.0 offers a sustainable path forward for modern supply chains.

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1. INTRODUCTION

Over the past decade, the logistics sector has undergone a significant digital transformation, driven by the increasing integration of technologies such as the Internet of Things (IoT), cyber-physical systems, and artificial intelligence (AI). This evolution has culminated in the emergence of Logistics 5.0, a new paradigm that transcends the traditional focus on operational efficiency by placing greater emphasis on sustainability, human-centric design, and resilience (Shojaeinasab et al., 2022).

Unlike Logistics 4.0—which primarily sought to optimise processes through automation, digitalisation, and real-time data analytics—Logistics 5.0 repositions logistics as a socio-technical system where human values and ecological considerations are embedded into the heart of operational design (Barata & Kayser, 2023). This shift reflects a growing consensus that future logistics systems must not only be fast and accurate, but also adaptive, inclusive, and ethically governed.

This reconfiguration is unfolding against the backdrop of profound global disruptions: climate volatility, geopolitical instability, energy transitions, and post-pandemic economic restructuring. These forces are reshaping the landscape of supply chain management, compelling organisations to seek not only efficiency but also flexibility, robustness, and social legitimacy (Zreik, 2023). In this context, Logistics 5.0 is emerging as a framework that aligns digital intelligence with planetary boundaries and evolving human needs.

Central to this transition is artificial intelligence, which plays a dual role as both an enabler of automation and a catalyst for strategic reorientation. AI technologies such as machine learning, computer vision, and natural language processing are no longer confined to isolated optimisation tasks—they are now embedded across the entire logistics value chain, supporting functions ranging from predictive maintenance and route planning to intelligent warehousing and decision support (Machado & Rodriguez, 2025). However, AI's contribution in Logistics 5.0 goes beyond technical performance: it shapes how humans and machines collaborate, how organisations learn, and how logistics systems adapt to complexity.

Moreover, the convergence of AI with smart city infrastructures, green transition goals, and global trade systems reinforces the need for holistic and interdisciplinary approaches. Logistics is no longer a backstage function; it has become a strategic lever for territorial development, sustainability transitions, and digital sovereignty. This evolution requires scholars and practitioners alike to rethink logistics not simply as a set of flows, but as a living, learning, and ethical system.

This chapter aims to examine the transformative role of artificial intelligence in enabling Logistics 5.0, with a focus on both technological enablers and organisational realities. Drawing from recent literature and empirical cases, it explores the

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