Chapter 9
Artificial Intelligence for Greener Warehousing: From Predictive Planning to Operational Excellence

R. N. Ravikumar
https://orcid.org/0009-0009-3705-1681
Marwadi University, Rajkot, India

S. Aarthi
https://orcid.org/0009-0006-9064-2091
Marwadi University, Rajkot, India

Samariddin Makhmudov
https://orcid.org/0009-0008-2046-8889
Termez University of Economics and Service, Termez, Uzbekistan

ABSTRACT

Energy efficiency and sustainability are key priorities in modern warehousing and logistics. AI plays a transformative role by enabling smart operations through accurate demand forecasting and inventory management. Traditional models often lead to overstocking, understocking, and energy waste. AI techniques such as time-series models, RNNs, and adaptive systems support just-in-time inventory, reduce resource use, and cut emissions. Integrated with IoT, RFID, and WMS, AI improves storage, picking, and restocking, lowering labor and energy costs. It also manages slow-moving or excess stock to reduce waste. The chapter highlights AI's synergy with digital twins, cloud, and edge computing for adaptive, sustainable warehouses. Real-world case studies show gains in forecasting, carbon reduction,

DOI: 10.4018/979-8-3373-3176-8.ch009

and SKU efficiency. Key challenges like data quality and integration are addressed with practical strategies. AI, aligned with SDGs and carbon neutrality goals, is not just a tech upgrade but a core enabler of sustainable, intelligent warehousing.

1. INTRODUCTION

Greener Warehousing has revolutionized the warehousing sector since it aims at meeting the environmental sustainability objectives and energy efficiency requirements. The socio-economic equities that have typified the traditional warehousing models (generally arrested inventory control, manual handling and reactive supply chain) is not compatible with the new demands of the green and efficient supply chain. It is in this regard that Artificial Intelligence (AI) comes in as a disruptive technology to innovative, flexible and environmentally friendly warehousing processes (Drissi Elbouzidi et al., 2023a). In particular, the AI technology is being progressively crucial in assisting the minimization of wastes, energy conservation, and flexibility in the implementation of operations through demand forecasting systems and inventory management systems. When time-series and deep learning approaches are used, such as Recurrent Neural Networks (RNNs), warehouses will be able to achieve a very high predictability in how their products demand will be, thus preventing overstocking and understocking; both of which lead to using excessive amounts of energy. The implementation of AI in combination with real-time awareness of the Internet of Things (IoT) sensors and RFID and the powerful WMS facilitates dynamic inventory planning, improved warehousing, and optimized resource consumption on energy as well (Eldred et al., 2023). It is on this point that the author explores how the AI can change the nature of warehousing to make it an intelligent and eco-friendly area of the supply chain. It proposes the correlation between good forecasting, best inventory control, and sustainability as a unit whole and provides the most vital technologies, strategies, and processes that advance the solutions to the green in the warehouses.

1.1 Role of AI in Transforming Traditional Warehousing

The less modern warehousing operations tend to be more re-active, predominantly labour-intensive, and inflexible, which, most frequently, leads to inefficiencies in controlling inventories, resources, and energy. Such old systems operate based on stagnant patterns and fail to embrace flexibilities in the market dynamics leaving them to be either overstocked or even out of stocks resulting into wastages in their operations. The concept of AI is a paradigm shift as it has become possible to employ data-driven, predictive, and self-optimization processes across the entire ware-