Chapter 1
Industry 4.0 and AI Transformation in Food SCM

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ABSTRACT

Artificial intelligence (AI) and Industry 4.0 are transforming food supply chain (FSC) by providing leading-edge solutions to enduring problems. This transformation uses latest technologies like blockchain, Internet of Things (IoT), AI-driven automation, and big data analytics to improve supply chain resilience, product and process quality along with significant improvement of operational efficiency. AI will help contribute towards waste reduction, improve inventory management while enabling predictive analytics for demand forecasting. The integration of AI and Industry 4.0 technologies in frozen FSC management is examined in this study, along with its advantages, disadvantages, and future prospects supporting the assumption that together AI and Industry 4.0 have the distinct ability to bring about significant transformation in the frozen FSC management through more effective decisions and collaboration. The study reflects on real benefits being waste reduction, cost reduction, and huge impact on the ecology.

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INTRODUCTION

This chapter offers a logical flow to deliberate upon different aspects of employing Artificial Intelligence (AI) and Industry 4.0 to help bring about a digital transformation in the food supply chain. Since the present frozen FSC (food supply chain) is still at an evolving stage, dominant application of technology is needed for improved optimization of food supply chain management (SCM), especially considering the predicted substantial demand and growth in the sector. Further, each section and subsection are explored through relevant examples, case studies, and facts to ensure a full understanding of the subject matter being studied.

Overview of Artificial Intelligence

Artificial intelligence (AI) is a field that was established more than 65 years ago. The field began with high expectations and supercilious objectives, moved through several phases of popularity, and most recently saw a renaissance owing to the development of deep neural networks (Emmert-Streib et al., 2020). McCarthy first used the term artificial intelligence in 1956 (McCarthy et al., 2006) at the Dartmouth conference, which launched a focused effort in this field of study. As per a study by Crevier (1993), initially the key focus of artificial intelligence was reasoning and symbolic models before it shifted to expert systems and neural networks and expert systems. Deep neural networks, another resurgence of neural networks, were made possible by the availability of Big Data in the early 2000s. Today, a variety of sectors including speech recognition, robotics, facial recognition, finance, and healthcare have seen significant success with the help of AI.

The term “intelligence” in AI was defined as:

$$\text{universal intelligence of agent } \pi = \Upsilon(\pi) = \sum \mu \in E 2^{-K(\mu)} V_{\pi\mu}$$

where K - Kolmogorov complexity function, π - agent, E - environment set, μ - environment set, $V_{\pi\mu} V_{\mu\pi}$ - value function and $2^{-K(\mu)} 2^{-K(\mu)}$ - algorithmic probability distribution over environment and $\Upsilon(\pi)$ - universal intelligence of agent π (Legg & Hutter, 2007).

The equation thus provides a way to quantify intelligence by measuring an agent's capacity to accomplish objectives in a variety of settings. However, the equation is highly complicated and unintuitive with exact computation of Kolmogorov complexity function K being a challenge therefore, a precise practical evaluation is not feasible. According to Performing such an intelligence test is also is a challenge as an agent may seem intelligent without truly possessing intelligence. That signifies the challenge in neither possessing an acceptable definition for “intelligence” nor having any test that can identify it in a reliable manner.