


Chapter 4

Sustainable E-Commerce for Industry 5.0: Leveraging Life Cycle Assessment for Greener Consumer Choices

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ABSTRACT

The rapid growth of e-commerce has transformed consumer behavior, offering unprecedented convenience but also contributing to significant environmental challenges. In the transition towards Industry 5.0, where human-centric and sustainable innovation is paramount, there is an increasing focus on minimizing the ecological footprint of online businesses. This article explores how Life Cycle Assessment (LCA) can be leveraged within e-commerce to drive greener consumer choices and sustainable operations. By evaluating the environmental impact of products and services from production to disposal, LCA provides critical insights that can inform eco-friendly decision-making for both businesses and consumers. The study highlights innovative strategies for integrating LCA into e-commerce platforms, enabling transparency, promoting sustainable consumer behavior, and aligning with the ethical imperatives of Industry 5.0. It also examines the role of emerging technologies such as artificial intelligence, big data, and blockchain in optimizing LCA processes and delivering actionable insights.

INTRODUCTION

E-commerce has rapidly evolved from a niche market to a global economic powerhouse, fundamentally reshaping the way people shop and businesses operate. From its early beginnings in the 1990s, with the rise of pioneering platforms such as Amazon and eBay, e-commerce has seen exponential growth. Today, it accounts for trillions of dollars in global trade, with projections estimating that e-commerce

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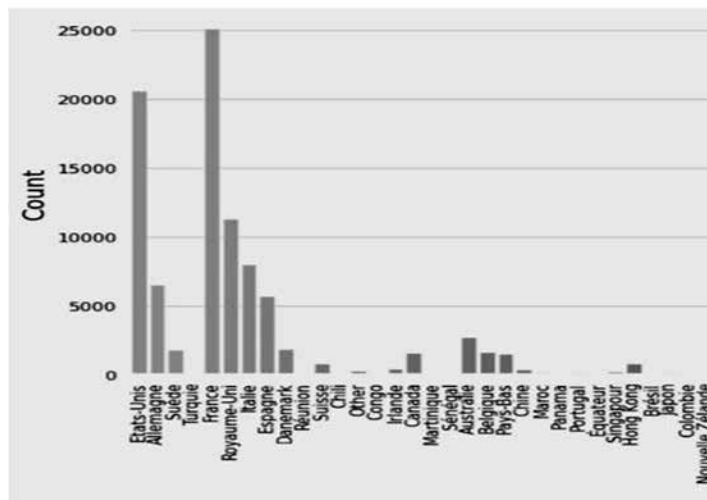
sales will reach nearly \$6 trillion by 2024. The convenience, speed, and accessibility of online shopping have driven consumer adoption worldwide, transforming retail, logistics, and supply chains.

However, this meteoric rise has not come without consequences. The environmental footprint of e-commerce has become a significant concern, driven by factors such as increased packaging waste, energy-intensive logistics, and the growing demand for same-day delivery services. A 2019 report by the International Energy Agency highlighted that the carbon emissions associated with freight transportation in e-commerce could rise by 30% by 2030 if no interventions are made. This has amplified the need for more sustainable practices within the sector.

As the global community embraces Industry 5.0—a new era of industry that emphasizes human-centricity, sustainability, and the integration of advanced technologies—the challenge of mitigating e-commerce’s environmental impact becomes even more pressing. Central to achieving a more sustainable e-commerce future is the adoption of Life Cycle Assessment (LCA). LCA is a methodology that evaluates the environmental impact of a product or service at every stage of its life, from raw material extraction to disposal. By integrating LCA into e-commerce platforms, businesses can offer greater transparency to consumers, empowering them to make greener choices.

This article explores how LCA can be a game changer for the future of e-commerce within Industry 5.0. It delves into the history of e-commerce, its environmental impact, and the role of LCA in fostering sustainable consumption. Through the lens of emerging technologies such as artificial intelligence and blockchain, this study also investigates the ways in which e-commerce can evolve into an eco-friendlier industry, aligned with the values of Industry 5.0. Figure 1 shows Count of ecommerce activity with country.

Figure 1. shows Count of ecommerce activity with country



From the above Figure 1, The utilization of advanced natural language processing (NLP) techniques, driven by the advancements in deep learning and language modelling, enables enterprises to derive significance from extensive textual datasets. Sentiment analysis, entity recognition, and subject modelling facilitate the comprehension of customer reviews, social media discussions, and product descriptions.

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