Chapter 12
Generative AI in Innovative and Eco-Friendly Packaging Solutions

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ABSTRACT

This chapter examines how generative AI is being used to solve innovative packaging solutions that minimize or reduce their impact on the environment. The concept here is to show how generative AI improves the packaging design by assessing sustainability, durability, and material utilization, which in turn enables the design and creation of smarter sustainable substitutes. AI algorithms allow the designers

DOI: 10.4018/979-8-3693-9856-2.ch012

to run several hundreds of permutations across the design canvas, thus achieving packaging that is made from recycled or biodegradable material and a net total carbon footprint. The chapter also looks at how generative AI improves efficiency in package creation, from its design to its manufacture. Therefore, through the detailed chapter analysis, we showcase the appropriate use of packaging from the AI perspective and explore trends by considering generative AI as a critical tool that will help in achieving environmental sustainability goals as well as addressing global packaging challenges.

1. INTRODUCTION

1.1 Overview of Generative AI

AI can be used in sustainable packaging through generative AI, which is helping in reducing the effects on the environment. Another application area of packaging, which can be optimized by generative AI to cut down material utilization, eradicate wastage, and enhance the package's recyclability. To evaluate the effectiveness of the solutions, it enables the modeling of various packaging schemes and the design of packaging, from environmentally friendly or biodegradable materials. AI can also identify specific packaging waste streams, promote the circular economy, and improve the efficiency of recycling processes. Customer awareness of environment-friendly products, and the rate of environmental degradation has increased, hence the call for change by the packaging industry. In some cases, the sustainability of the package design is a compromise between maintaining utility and reducing the negative effect on the environment. Its objective is to minimize environmental impacts by getting the most out of resources and designing materials. Due to their high rate of resource use and generation of waste, the wood packaging and wood board industries are the focal point of the global shift towards sustainability (Li Lixu *et al.* 2024). These businesses have long depended on processes that are very damaging to the environment by using a great deal of virgin wood and generating a great deal of waste. Possibly mitigating these impacts, digital technologies present an actionable strategy for redesigning and remanufacturing wooden goods. The wood board and packaging industries are under pressure to reduce their environmental footprint as the demand for green packaging solutions rises. These industries, which are core in construction, furniture production, and logistics transportation, have been the main culprits in deforestation and wastage. The next important strategy in the design of sustainable packaging is known as Design for Disassembly. This means identifying elements and design approaches that facilitate assembly and disassembly and, on

Food Security and Rural Development on Emerging Markets of Northeast Asia: Cases of Chinese North and Russian Far East

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