Smart Packaging Main Trends

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Abstract

Globalization, innovative technologies and the ever-increasing demands of consumers have a significant influence on the packaging industry, which is constantly growing. Smart packaging is that which integrates technological elements to provide additional information about the product or to improve the user experience Current trends in product packaging are characterized by a balance between innovation, sustainability and consumer experience. From the use of ecological and innovative materials to the creation of interactive, personalized and authentic packaging, the packaging industry is evolving rapidly, responding to market demands and environmental challenges. The present work aims to present these and to draw attention to the importance of this industry while highlighting some necessary aspects in consumer education, especially with regard to CPG. In this regard, the main trends have been identified and the main forms of materialization regarding smart packaging have been presented.

Key words: smart, package, innovation, sustainability.
J.E.L. classification: L66, O14, O32, Q01, Q55.

1. Introduction

Over the years, various product packaging trends have evolved internationally, with the aim of offering customers a new experience. It is clear that smart packaging can bring many benefits to the various links in the supply chain, such as the ability to quickly remove and replace packaging containing products in poor condition within a batch. In addition, this type of packaging also allows the quality of a packaged product to be analyzed much more quickly and economically. (https://www.spg-pack.com/fr/blog/emballage-intelligent-represente-veritable-revolution-secteur/)

As more and more businesses embrace e-commerce, which has seen tremendous growth in recent years, companies have paid increasing attention to e-commerce packaging to ensure that products reach their recipients safely, improving the customer experience.

Smart packaging is a container capable of monitoring the condition and quality of products during storage and transport. It is an evolution of traditional packaging that will detect and record changes in the product's environment; it is a major step forward for the industry, particularly in the food sector.(https://www.mecalux.fr/blog/emballage-intelligent)

Smart packaging helps improve merchandise management because it is developed specifically to reduce waste, improve food safety, and ensure maximum product quality. However, its cost makes it difficult to popularize, despite its undeniable advantages. As this type of packaging becomes more widespread, both companies and consumers will benefit. Supply chain management will also be much smoother and more efficient, as warehouse managers will have all the information they need to ensure optimal storage and shipping conditions. (https://www.mecalux.fr/blog/emballage-intelligent)

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In recent years, the packaging industry has incorporated revolutionary technologies that could take the world of packaging to the next level, and smart packaging is a good example of this. If the main function of packaging is to preserve food in optimal conditions, smart packaging is responsible for transmitting this information to the consumer by providing more data on the state of the food. (https://www.spg-pack.com/fr/blog/emballage-intelligent-represente-veritable-revolution-secteur/)

2. Theoretical background

Smart packaging represents a new approach to emerging technologies in the packaging industry that ensures both increased consumer satisfaction and business success. Although the concept of smart packaging is still new, the concept includes various technologies designed to achieve more than just packaging. (Greaves, 2024)

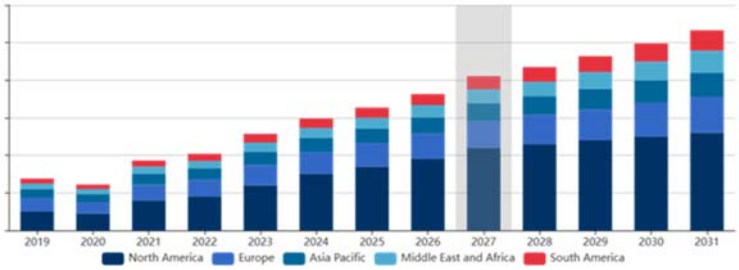
This type of packaging provides for products buyers real-time information and includes digital identifiers such as quick recognition (QR) codes, barcodes or radio frequency identification (RFID) technology; in this way, retailers can also obtain data throughout the technical circuit.

As these packaging technologies gain traction, their market is growing and is expected to reach $38.3 billion by 2033, with a compound annual growth rate (CAGR) of 4.5%. (https://customboxesnow.com/blog/what-is-smart-packaging/)

Cognitive Market Research has recently published the 7th edition of *Smart and Intelligent Packaging Market Report 2024.* Quantitatively, it provides quantitative data, current market size, competitor market shares, market forecast and other industry updates at global, regional and country levels. Qualitative data refers to market drivers, constraints, current trends, opportunities and more. (Deore,2024)

The forecast refers to the evolution of revenues until 2031 at international, regional and country levels and analyzes the main recent trends for each smart packaging application. On this basis, the demand for smart packaging for various end-use industries can be analyzed, as shown in the figures below:

Figure no. 1. Smart and Intelligent Packaging Market Share (%) by Region (2019-2031)

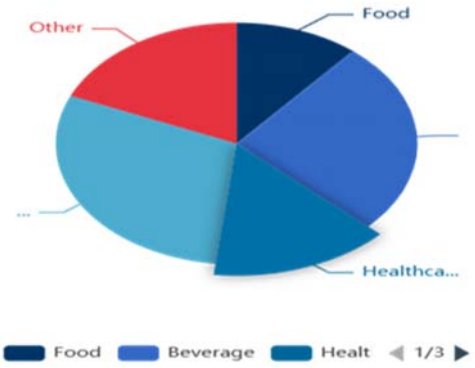


Source: Smart And Intelligent Packaging Market Report 2025/ Global Edition

The global smart packaging industry is growing as more brands embrace this cutting-edge technology. A recent report by Data Bridge shows that the global packaging market will grow by 7.4% by 2027, reaching $31.94 billion.

Given the success of the application of these technologies, studies conducted predict a sustained development of the smart packaging market in the long term.

Figure no. 2. Smart And Intelligent Packaging Market Share (%) by Application in 2023-2031



Source: Smart And Intelligent Packaging Market Report 2025/ Global Edition

The conclusion is that the global smart packaging market is experiencing significant growth in the near future, especially the Active Packaging segment. Furthermore, the food segment is expected to experience significant expansion in this regard. In this respect, many companies in the field will focus on strategies to consolidate their product portfolio to expand their businesses in the global market. (Deore, 2024)

In the context of the constant growth of the packaging industry, technological innovations play also an essential role. According to a study, the quality of logistics services significantly influences the level of customer satisfaction and customer retention rate in e-commerce. This is vital for the smart packaging industry, which strives to improve user experience by integrating advanced technologies. (Micu et al, 2013)

Furthermore, the importance of business modeling for the circular economy must be emphasized, a principle that can also be applied to the development of sustainable packaging. (Herciu et al, 2 023)

Additionally, consumer trust in artificial intelligence algorithms used in e-commerce should be highlighted, being a factor to consider when designing smart packaging that aims for personalization and interactivity. Therefore, it is important to educate consumers about the benefits and complexities of smart packaging to support its widespread adoption. (Teodorescu et al, 2023)

3. Research methodology

This paper aims to provide an overview and analysis on the role and importance of smart packaging. The main method used is qualitative research using documentation that aims to highlight the trends and benefits that this approach could bring to an organization and to society in general. The information necessary to conduct this research was accessed through documentary research as the main theoretical basis but also support for starting investigations at the level of the smart packaging industry.

The research highlights the clear growth trends of the smart packaging market and suggests that most companies that sign up in this direction will register clear gains and should be more involved in communicating both the social responsibility initiatives that this approach implies.

4. Findings

The research showed that although smart packaging applications are still in their early stages, the integration possibilities of these new practices are significant. This concept offers packages with extended functions, including various technologies designed to do more than just packaging, with benefits for both consumers and distributors of the products concerned.

We can take into consideration two types of smart packaging: active and intelligent. Active packaging interacts with the contents of a package to extend shelf life, often used in food packaging. This includes integrated ethylene absorbers, light filtering materials, oxygen absorbers, moisture control inserts, or antimicrobial coatings.

To communicate vital information such as product temperature, storage time or handling maneuvers, sensors and indicators are used in the smart packaging sector. Examples of this include time-temperature indicator labels. (https://customboxesnow.com/blog/what-is-smart-packaging/)

The main advantages of smart packaging, could be listed as following:

- *Customer empowerment*- through the digital indicators mentioned above;
- *Quality control*- and monitoring the various stages of product quality to correctly indicate their shelf life;
- *Staying relevant with customers*- due to an improved experience due to the information provided to potential consumers ;
- *Improved inventory management*- by stocking a quantity of goods to meet demand;
- *Greater sustainability*- by providing additional information on environmental protection;
- *Creating Theft, Substitution, and Counterfeit-Proof Products*- by improving the experience of tracking and communicating product status;
- *Predictive Planning*- by giving suppliers the opportunity to more quickly understand details related to product availability;
- *Brand Transparency*- considering the importance of raising consumer awareness regarding the economic, social and environmental impact;
- *Increasing Likelihood of Positive Experience*-. because customers have the opportunity to be active and increase their knowledge of the products they want to purchase and introducing a smarter way to package software. (https://impacx.io/blog/what-is-smart-packaging-and-its-benefits/)

From another point of view, smart packaging can be divided into two major categories, structurally functional and materially functional. This classification takes into account the general functions related to identification, detection, recording, tracking, but also the advantages of smart packaging compared to traditional packaging. These advantages refer to increasing logistical efficiency, quality control, supporting consumer rights and interests, or reducing environmental pollution. (https://ro.wxsmartbag.com/news/two-major-types-of-smart-packaging-71397742.html)

The evolution of various product packaging trends has also taken place in many CPG (Consumer Packaged Goods) brands internationally, with the aim of offering customers a new experience. CPG are items used daily by average consumers that require routine replacement or replenishment, like food, toilet paper, or cosmetics. The CPG industry is one of the largest sectors in the U.S. economy and the name originates in their packaging, which traditionally is easily recognizable wrapping that consumers can quickly identify on store shelves. (Bloomenthal, 2024) (https://ecommerce-platforms.com/ro/glossary/what-is-cpg)

Within the smart packaging market, there are several sectors, such as food & beverage, healthcare, automotive, personal care and others. Food & Beverage is the dominant sector and it is estimated that this trend will continue in the 2025-2030 time horizon. This evolution is undoubtedly the consequence of the growing need felt in terms of smart packaging solutions due to the previously presented advantages regarding the quality and safety of consumption and the requirements of environmental protection. (Chaudhary, 2023)

In practice, several types of smart packaging are used, incorporating different systems. We can thus find:

- Identifiers: the most common type of smart packaging, which although not very innovative, are able to provide more information to the consumer and which usually integrate a QR code in which the traceability or origin of the product can be quickly verified;
- Indicators: which indicate changes related to the temperature or freshness of food, interruptions in the cold chain or the degree of maturity of a fresh product;
- Sensors: which allow the detection of biochemical compounds secreted by food when it begins to degrade.

(https://www.spg-pack.com/fr/blog/emballage-intelligent-represente-veritable-revolution-secteur/)

There are thus many types of smart packaging, the main trends recorded should be highlighted, as follows:

- *anti-counterfeiting packaging*: this type of solution involves QR code-based identification, which can guide and help the end user and the company's salesperson to scan and identify the authenticity of a product using smartphone devices;
- *sustainable packaging*: along with ecological packaging, they represent essential concepts in the current context of environmental protection and increasing consumer demands regarding the impact that products and their packaging have on the quality of life;
- *minimalist packaging*: this trend is increasingly popular among brands that want to convey a message of elegance, quality and authenticity;
- *storytelling packaging*: represents an innovative approach to packaging design, which integrates narrative elements to create an emotional connection between the product and the consumer, including through personalized packaging that reflects special moments or events or story elements about the brand's tradition and history;
- *packaging that can collect feedback*: involves the integration of interactive technologies or QR code or AR (augmented reality) elements on packaging, which allow brands to interact directly with consumers and collect real-time feedback about the product or consumer experience;
- *customized packaging*: which helps differentiate products while also contributing to building an emotional connection between brand and customer;
- *functional packaging*: those that, along with product protection, improve the consumer experience through more practical and easy-to-handle use, being not only attractive but also economical, reducing waste and maximizing value for consumers;
- *zero waste packaging*: which promotes waste reduction and material reuse.

Another perspective identifies three other types of smart packaging:

- Consumer engagement - educational, entertaining or as part of a loyalty program.
- Product authentication and brand protection - for brands looking to highlight a product's authenticity or sourcing story, connected packaging can be used to provide detailed information unique to that individual item.
- Track and trace - tracks the journey of a package (and product) from start to finish.

(https://epacflexibles.com/what-is-smart-packaging/?srsltid=AfmBOoph16AYMtVKDgkxf4wazcoEIHH8TfiMzHj8w483EI9GddzuHmzS)

Along with the aspects presented, other trends can be highlighted, such as:

- *automation and innovations in packaging production*: advanced technologies, such as 3D printing and robotics, allow the creation of more complex and/or personalized packaging in a shorter time, while also helping to reduce material waste;
- *transparent versus opaque packaging*: this trend emphasizes the importance of transparency and brand trust;
- *active packaging*: food packaging that can extend the shelf life and thus reduce food waste and contribute to increasing demand.
- *using biological packaging materials:* such as mushrooms instead of polystyrene or beverage containers made from algae. (https://www.sustainable-futures2030.org/rapoarte/)

Sustainability must continue to be a key focus for the packaging industry. It is important for every business to adopt initiatives across the entire product lifecycle to align with the demands of the circular economy. As more and more businesses embrace e-commerce, which has seen tremendous growth in recent years, companies have paid increasing attention to e-commerce packaging to ensure that products reach their recipients safely, improving the customer experience.

5. Conclusions

Practice validates the undeniable benefits of smart packaging by providing sustainable ways to extend the functionality of product packaging to meet implicit or explicit needs. Thus, consumers will be faced with accepting additional benefits and, sometimes, changing old habits. In turn, companies will need to identify technologies that work and can ensure differentiation from competitors.

However, the high price is the main difficulty that still delays the widespread use of smart packaging. It is estimated that in the near future new high-performance technologies will be developed, which will allow reducing production costs and will allow the widespread use of smart packaging in all fields, for the most diverse products.

It can thus be appreciated that the global smart packaging market will register significant growth in the near future. The food segment is expected to expand to a significant position.

In this context, most of the key companies are focusing on their own strategy building models to strengthen their product portfolio and expand their businesses in the global market.

In conclusion, current trends in product packaging are characterized by a balance between innovation, sustainability and consumer experience. From the use of eco-friendly and innovative materials to the creation of interactive, personalized and authentic packaging, the packaging industry is evolving rapidly, responding to market demands and environmental challenges.

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