

Reform Practice of the "Packaging and Culture" Course at Shenzhen Polytechnic University: Reunderstanding of Packaging Based on the Ten Major Relationships

Linyi Chen¹, Xun Chen^{1,*}, Hanzi Dong²

¹*School of Digital Media, Shenzhen Polytechnic University, Shenzhen, Guangdong, China*

²*Harbin University of Science and Technology, Weihai, Shandong, China*

**Corresponding Author*

Abstract: The original course content of "Packaging and Culture" was disorganized and redundant, failing to effectively guide students in comprehensively and systematically understanding packaging, and achieve the teaching objectives of the course. The new curriculum design is based on the ten major relationships: packaging and history, packaging and goods, packaging and users/consumers, packaging and branding, packaging and life/health, packaging and environment, packaging and technology, packaging and supply chain/industry chain, packaging and culture/art, packaging and the future. The curriculum system and teaching content have been restructured, incorporating thematic sharing sessions by industry experts, enterprise visits, exhibitions and other methods are enable to students to comprehensively and systematically understand "what packaging is", better grasp the development status and trends, opportunities and challenges faced by the packaging industry, enhance students' sense of identity, confidence and pride in the packaging industry, profession, occupation and enterprise, stimulate students' learning interest, enthusiasm and subjective initiative. Provide guidance for their future professional learning and sustainable career development.

Keywords: Packaging; Ten Major Relationships; Curriculum Reform

1. Research Background

The course Packaging and Culture is a foundational course in the Packaging Planning and Design major at Shenzhen Polytechnic University, designed for first-year students. Equivalent to Introduction to Packaging or Fundamentals of Packaging, the course previously covered diverse aspects including the

history and current status of packaging, the relationship between packaging and culture, packaging design, packaging materials and performance testing, packaging printing and post-press processes, packaging machinery and equipment, packaging standardization, and green packaging. However, the teaching content was fragmented and redundant, failing to effectively guide students to form a comprehensive and systematic understanding of packaging and to achieve the intended teaching objectives of the course. Therefore, reforming the existing course design and restructuring its teaching content has become urgent and necessary.

2. Overall Framework of the Course and Teaching Content Design for 'Packaging and Culture'

As illustrated in Figure 1, the reformed overall framework for the Packaging and Culture course, alone with its teaching content, is grounded in four core construction principles: ideological and political education, value guidance, university-enterprise co-construction, integration of work and study, digital technology, comprehensive integration, student-centered, continuous improvement. Through lectures on the brief history of packaging (packaging and history) and analysis of the current situation, trends, opportunities and challenges confronting China's packaging industry (packaging and future), students are introduced to the role, status and significance of packaging in human civilization and socio-economic development. Through representative packaging design cases in the fields of consumer electronics, tobacco and alcohol, cosmetics, gifts, tea, food, beverages, agricultural and sideline products, students will be analyzed on the relationships between packaging and goods, packaging and users/consumers, packaging and brands, packaging and life/health, packaging and

environment, packaging and technology, packaging and supply chain/industry chain, packaging and culture/art, etc. Renowned experts in packaging design, engineering, young entrepreneurs, and outstanding alumni are invited to deliver thematic lectures, sharing insights from multiple perspectives, including packaging design, manufacturing, career and entrepreneurial experiences, industry views, opportunities and challenges within the sector, corporate culture, talent selection and employment standards, career development pathways, and university career planning. Students are also organized to visit representative enterprises in the packaging industry, including those related to design, media, and intelligent manufacturing. Additionally, they are encouraged to attend professional exhibitions within the packaging

and related upstream and downstream industries for field research and study.

Through inquiry-based learning focused on the “Ten Relationships of Packaging,” complemented by expert lectures, enterprise visits, and exhibition participation, students can develop a comprehensive and systematic understanding of “what packaging is and what packaging signifies.” This approach equips them to better grasp the current situation, trends, opportunities, and challenges of the packaging industry, thereby enhancing their sense of identity, confidence, and pride in the packaging profession, industry, and enterprises. Additionally, it stimulates students’ learning interest, enthusiasm, and initiative, providing valuable guidance for their professional studies over the subsequent three years and supporting their sustainable career development.

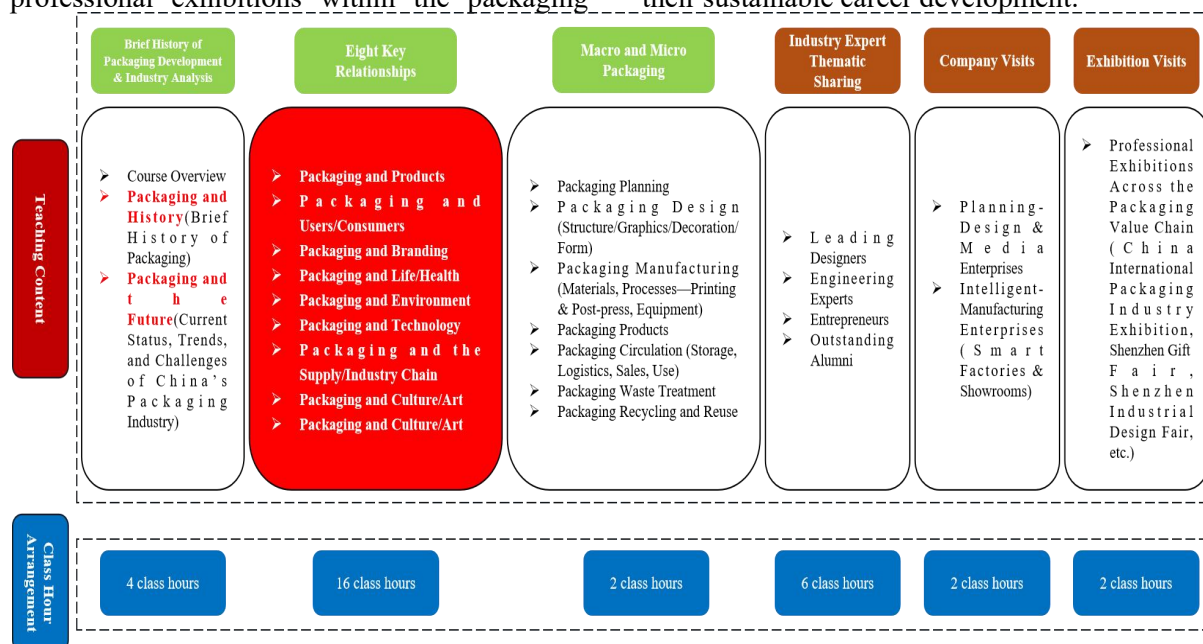


Figure 1. Overall Framework of the Packaging and Culture Course and Teaching Content Design

3. The Ten Relationships of Packaging

3.1 Packaging and History

As productivity improves, science and technology advance, and culture and art develop, packaging has undergone a lengthy evolutionary process. It can be stated that the history of packaging development is nearly synchronous with the history of human civilization, serving as a microcosm of human progress and transformation. The evolution of packaging can be roughly categorized into four stages: the Primitive Packaging Stage, the Ancient

Packaging Stage, the Modern Packaging Stage, and the Contemporary Packaging Stage [1].

3.1.1 Primitive packaging stage

During the Paleolithic Age, primitive humans exhibited extremely low productivity levels. For survival, they relied on manual labor and simple tools to gather wild fruits, fish, and hunt. To store and transport the food they obtained, they utilized plant leaves, bark, or animal hides to wrap the food, or tied it using plant vines and fibers. Sometimes they employed bamboo tubes, gourds, shells, or animal horns as containers. These practices constituted direct utilization of natural resources and represent the earliest forms

of primitive packaging, as shown in Figure 2.

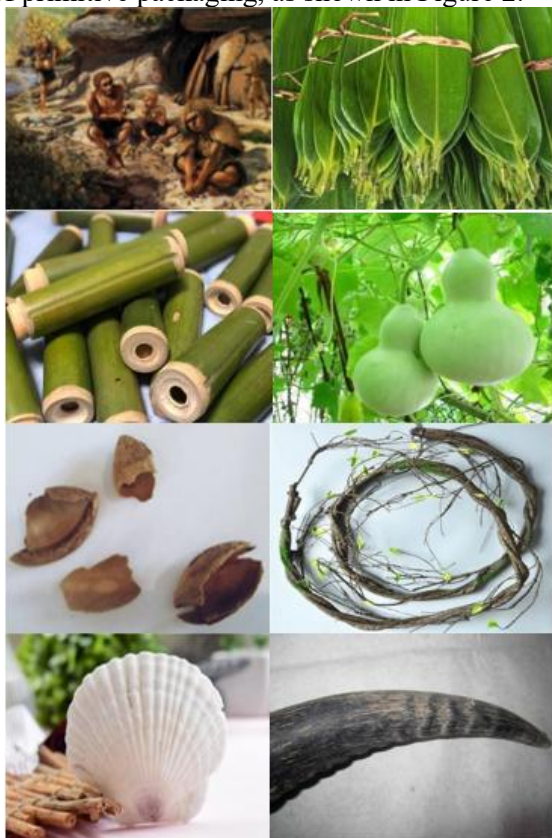


Figure 2. Main Forms of Primitive Packaging

3.1.2 Ancient packaging stage

During the middle period of the Neolithic Age,

humans invented pottery. The emergence of pottery represented a creative activity in which one material was transformed into another through chemical change, marking humanity's first deliberate act of altering the properties of natural materials through conscious intention. This innovation enabled longer-term food storage and signified a new chapter in human civilization. Consequently, pottery packaging can be regarded as the first major advancement in the development of ancient packaging. Painted pottery vessels adorned with decorative patterns, characteristic of the Painted Pottery Culture, have been unearthed from Neolithic cultures in China such as Yangshao, Majiayao, and Dawenkou, as shown in Figure 3.

After the late primitive society, as productivity advanced, commodity production and exchange began to emerge. Packaging gradually distinguished itself from general containers and utensils, evolving into a purposeful activity aimed at protecting goods, facilitating storage and transportation, and increasing product value. At this time, packaging not only fulfilled its basic protective and functional roles but also began to meet aesthetic needs—humans created packaging containers of various shapes and designs to enhance added value and satisfy spiritual and cultural aspirations.



Figure 3. Yangshao Boat-shaped Painted Pottery Pot (Left) and Majiayao Painted Pottery (Right)

During the Ancient Packaging Stage (approximately 4000–1000 BCE), new materials emerged, including metals, porcelain, glass, cloth, paper, and wood. New technologies also

appeared, such as metal smelting and vessel-making techniques, ceramic and glass firing, weaving and sewing, simple wrapping methods, and wood processing techniques.



Figure 4. Various Bronze Vessels from the Xia, Shang, and Zhou Dynasties

Bronze packaging represented one of the typical forms of packaging during this period. Bronze, a significant innovation in the history of metal smelting, is an alloy produced by melting copper and tin at high temperatures. It exhibits a low melting point, high hardness, strong malleability, and a bright luster. In comparison to pottery, bronze packaging offered greater durability and superior sealing properties, leading to its widespread use for storing daily necessities and ritual objects. Chinese bronze ware experienced particularly flourishing development during the Xia, Shang, and Zhou dynasties, as illustrated in Figure 4. The advent of bronze vessels progressively replaced pottery as the primary container type, signifying humanity's transition into the Metal Age. Thus, bronze packaging can be considered the second major advancement in the evolution of ancient packaging.



Figure 5. Baqiao Paper from Emperor Wu's Reign in the Western Han Dynasty and Caihou Paper from Emperor He's Reign in the Eastern Han Dynasty

Paper, as one of the Four Great Inventions of ancient China, occupies an indispensable position in the history of world civilization. The Baqiao Paper, Caihou Paper, and Recycled Paper ("Huanhun Paper") are three historically significant types of paper, each representing distinct periods and techniques. The Baqiao Paper, discovered in 1957 in Xi'an with paper fragments found on a bronze mirror from the reign of Emperor Wu of the Western Han Dynasty, pushed back the origin of papermaking in China to an earlier date. The Caihou Paper, produced during the reign of Emperor He of the Eastern Han Dynasty, improved paper quality, increased production capacity, and reduced costs, leading to its widespread use in writing, painting, and packaging, as illustrated in Figure 5. The Recycled Paper was manufactured through de-inking, pulping, and papermaking processes that reused waste paper, aligning with sustainable development concepts. Consequently, paper packaging can be regarded as the third

major leap in the development of ancient packaging.

3.1.3 Modern packaging stage (Early modern period)

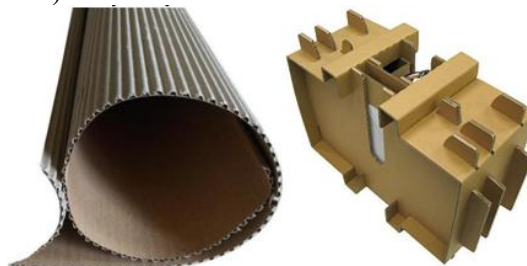


Figure 6. The Invention of Single-Faced Corrugated Board and the Emergence of Corrugated Boxes for Transport Packaging

This stage mainly encompasses the period from the 16th to the 19th century. During this era, new materials emerged, including tinplate, processed paper, corrugated cardboard, polymer materials, and composite materials. Concurrently, new technologies developed, such as can-making, material lamination, bottle-making, metal tube manufacturing, artificial polymer synthesis, sealing techniques, and corrugated box production technologies.

Significant milestones of this period include: in 1856, British inventors Edward Cile and Edward Allen brothers corrugated paper; in 1871 and 1874, Americans Albert Jones and Oliver Long respectively invented single-faced and double-faced corrugated cardboard; and in 1894, the United States produced corrugated boxes for the first time, using them in transport packaging, as shown in Figure 6. In 1909, American chemist Beklan invented plastic (phenolic resin). In 1858, John Mason invented the threaded cap, and in 1892, William Painter invented the crown cap. The invention of bottle caps significantly improved the sealing performance of bottles, effectively solving the leakage problem of glass containers, as shown in Figure 7.



Figure 7. The Threaded Cap and the Crown Cap: Inventions Still in Use Today

3.1.4 Contemporary packaging stage

As productivity steadily improves, science and technology advance rapidly, consumer demand continues to upgrade and diversify, and the

commodity economy flourishes, the role of modern packaging has become increasingly multifaceted. Packaging now bears greater responsibilities, performs broader functions, and exhibits higher value. It can be stated that the packaging industry has entered a completely new stage of development, progressively evolving toward intelligentization, digitalization, greening, and integration. Currently, China's packaging industry has established a relatively complete system covering the entire life cycle of packaging products—from design, production, and testing to circulation and recycling. The industry is generally categorized into three major segments: packaging materials, packaging products, and packaging equipment, along with five primary sub-industries: paper packaging, plastic packaging, metal packaging, glass and ceramic packaging, and bamboo and wooden packaging. As illustrated in Figure 8, the packaging industry has emerged as a crucial component of the modern industrial system—a manufacturing service sector closely linked to the national economy and people's livelihood—and serves as a key supporting force for developing new quality productivity and achieving high-quality economic and social development.



Figure 8. A Diverse Array of Modern Packaging

3.2 Packaging and Products

According to the national standard GB/T 4122.1-2008 Packaging Terminology-Part 1: Basic, packaging is defined as: “A general term for containers, materials, and auxiliaries adopted by certain technical methods to protect products, facilitate storage and transportation, and promote sales during the circulation process; it also refers to the operational activities involving the application of such technical methods in the use of containers, materials, and auxiliaries for the above purposes” [2]. Therefore, packaging primarily serves as the product's or commodity's

“outer garment.” It supports the entire circulation process, including product storage, logistics, sales, and usage. Any planning, design, development, and production of packaging must center around the product or commodity itself, adhering to the three fundamental and essential functions of packaging: protecting the product, facilitating storage and transportation, and promoting sales.



Figure 9. Tetra Pak Products in Various Shapes and Types

A well-known example of how packaging embodies these three core functions is Tetra Pak. In 1952, Tetra Pak introduced its first tetrahedral-shaped packaging box, which replaced the heavy glass bottles used for milk packaging and distribution at the time. Since then, Tetra Pak has developed a full range of liquid food packaging products, including Tetra Classic, Tetra Brik, Tetra Pillow, Tetra Prisma, Tetra Rex, Tetra Gemina, Tetra Crystal, Tetra Fino, Tetra Wedge, and Tetra Top, as shown in Figure 9. Its global clientele includes leading Chinese brands such as Yili, Mengniu, Bright Dairy, Want Want, Vitasoy, New Hope, Coconut Palm, and Wahaha. Tetra Pak is a multilayer composite packaging made of paper, aluminum foil, and plastic. It effectively prevents air, light, and external contamination, thereby keeping milk and beverages safer, fresher, and longer-lasting while ensuring high packaging efficiency.

3.3 Packaging and Users/Consumers

Packaging is the element that consumers most frequently see and touch. It functions as the initial medium or bridge connecting brands, products, and consumers. In today's era of fragmented information, consumer attention is scarce and highly valuable. For brands to attract consumers and foster product preference within a very short timeframe, thereby driving purchase decisions, packaging design must meet extremely high standards.

Japanese design expert Fumihito Sasada notes in *The Power of 0.2 Seconds in Design* that when shoppers pass by shelves, a product enters their field of vision for only 0.2 seconds. This brief 0.2-second window is critical for capturing consumers' attention; during this instant, the product's recognizability and memorability become crucial [3]. A study by global market research and data analytics company Nielsen reveals that Chinese consumers spend only 3-7 seconds making purchasing decisions at shelves, with 64% of them selecting products based on packaging. Consequently, packaging must convey the product's key selling points within less than 7 seconds, quickly convincing consumers of its quality. Compared to general advertising campaigns, an exceptional packaging design can generate up to 50 times the return on investment.

Thus, packaging design should be people-oriented, guided by consumer needs, addressing their problems or pain points, and enhancing their user experience. This experience may encompass novelty, ritual, atmosphere, joy, warmth, participation, interactivity, trust, identity, dependence, empathy, futurism, imagination, or curiosity. Packaging design should create value for consumers-functional, emotional, and social value. Additionally, packaging must effectively extract and communicate a brand's core values, product advantages, and selling points in a direct, accurate, and comprehensive manner. This constitutes the essential "language" of brand packaging when engaging with consumers.

Below are two examples of user-centered packaging designs that enhance user experience. Figure 10 illustrates Best Childhood's "Edutainment" toy packaging, developed under the strategy of "packaging as a toy." This approach extends the product experience beyond a single purchase-and-use process, integrating it more deeply with reuse, early education, and parent-child interaction, thereby enhancing user participation throughout the product life cycle. Additionally, a set of blank boards was incorporated to encourage children's hands-on skills and drawing abilities, further reinforcing Best Childhood's "Intelligence + Aesthetics" product concept.

Figure 11 illustrates The Palace Food brand's "Boating on the Lake" Dragon Boat Festival gift box. The design ensures that the dragon boat's head and tail do not come into friction with the

gray board panels of the box, while presenting a dynamic scene of the dragon boat gliding smoothly across the lake's surface within limited space. This thoughtful structural and visual design enhances the consumer's sense of interactive delight upon receiving and unboxing the gift.



Figure 10. Best Childhood "Edutainment" Toy Packaging

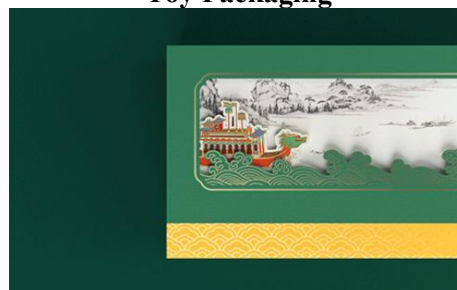


Figure 11. The Palace Food Brand's 'Boating on the Lake' Dragon Boat Festival Gift Box

3.4 Packaging and Branding

In today's increasingly competitive business environment, where consumer demands are becoming more diverse, the importance of packaging to a brand is self-evident. Its significance is primarily reflected in the following aspects: as the visual carrier of brand information, packaging serves as one of the key channels through which products and brand values are communicated to consumers; it functions as the first medium, direct language, and vital communication channel between the brand and the consumer; packaging acts as the brand's first image ambassador and silent salesperson; as a marketing tool, it represents

one of the most cost-effective forms of advertising; it reflects the brand's quality; and finally, it constitutes an important component of brand equity.

As illustrated in Figure 12, which depicts the evolution of packaging design for brands such as Coca-Cola and Nongfu Spring, packaging serves a function far beyond that of a mere vessel or protective layer. Behind every successful brand lies a strategic packaging design that has shared in the brand's journey through challenges and triumphs, aiding in maintaining the brand's presence in customers' memories and integrating it into their daily lives [4]. A brand is defined not by what it claims to be, but by what consumers perceive it represents about themselves. Consequently, in the process of packaging planning and design, key considerations for every packaging designer include how to highlight a brand's value and differentiation through packaging, attract consumers, and ultimately stimulate purchasing behavior.



Figure 12. Evolution of Coca-Cola Series Packaging Designs

3.5 Packaging and Life/Health

Wherever there are products, there is packaging. Packaging exists in every aspect of daily life-clothing, food, housing, and transportation. To illustrate the relationship between packaging and everyday living, the following example presents windowed packaging designs, which enhance transparency and intuitiveness for consumers during shopping.



Figure 13. Windowed Packaging for Macaron Desserts



Figure 14. Windowed Packaging for Fresh Meat

Windowed packaging incorporates openings on the display surface of the outer package, which are sealed with cellophane or transparent film to provide partial or full visibility of the contents. This packaging style typically manifests in two primary presentation forms: (1) Direct product display – This approach enables consumers to visually inspect and evaluate the product's appearance, facilitating their understanding of the contents, simplifying selection processes, and allowing verification of product quality. Figure 13 depicts windowed packaging for macaron desserts, where the open section emphasizes the vibrant colors and appealing shapes of the sweets, thereby stimulating appetite and purchase intent. (2) Creative composite design – This method integrates the window shape with the structural elements or illustrations on the packaging to form a novel composite image. Such designs are generally classified into product-related forms or playful forms. Figure 14 showcases a fresh meat package that combines a window shape with an animal motif, permitting consumers to directly assess the meat's quality while enabling quick differentiation between various types of meat.

3.6 Packaging and the Environment

Packaging presents a dual nature, functioning as both a beneficial tool and a potential environmental concern. On one hand, it serves important functions such as protecting products, facilitating storage and transportation, promoting sales, and enhancing brand value. On the other hand, during the production of packaging materials and products, packaging-related enterprises generate the so-called “three wastes”—wastewater, waste gas, and solid waste—which can cause environmental pollution. Furthermore, once packaging reaches consumers and is discarded after use, the majority of it becomes packaging waste, which continues to harm the environment.

Excessive packaging has long been one of the major issues facing the packaging industry. Excessive packaging refers to situations where

the packaging of a product exceeds its basic functional requirements-protection, ease of storage and transport, and sales promotion-by using excessive materials, oversized volume, overly complex layers, or unnecessarily high costs and ornate decorations. This phenomenon is often characterized by structural excess, material excess, and decorative excess [5]. The causes of excessive packaging are multifaceted. On one hand, the traditional Chinese cultural emphasis on “saving face” contributes significantly to excessive packaging, particularly in gift products such as mooncakes, rice dumplings, tea, liquor, and health supplements. On the other hand, the rapid expansion of the e-commerce and logistics industries-while greatly improving convenience in daily life-has also led to severe resource waste and environmental pollution problems, as illustrated in Figure 15.



Figure 15. Excessive packaging Phenomenon in the Express Logistics Industry

To curb excessive packaging, the State Administration for Market Regulation and the Standardization Administration of China have issued several national standards related to excessive packaging, including GB/T 31268-2014 General Rules for Restricting Excessive Packaging of Commodities, GB 23350-2021 Requirements for Restricting Excessive Packaging of Commodities-Food and Cosmetics, and GB 43284-2023 Requirements for Restricting Excessive Packaging of Commodities-Fresh Edible Agricultural Products. Among these, the latter two are mandatory standards, which came into effect on September 1, 2023, and April 1, 2024, respectively. Another major environmental issue faced by the packaging industry is “white pollution”, which arises from disposable plastic packaging products, as illustrated in Figure 16. Although

disposable plastic lunch boxes, bags, and similar items offer temporary convenience in daily life, once discarded into the environment-whether soil or ocean-they are extremely difficult to decompose (requiring approximately 200 years), thereby generating long-term and severe ecological problems.



Figure 16. Environmental Issue of “White Pollution” Caused by Disposable Plastic Packaging Products

In fact, as early as the 1980s, the international community had proposed the concept of green packaging in response to white pollution caused by plastic and other packaging wastes. Green packaging refers to packaging that is harmless to the ecological environment and human health, can be reused and recycled, and promotes sustainable social development. The development of green packaging has gone through three important stages: Stage 1 (1970s–mid-1980s): The concept of packaging waste treatment, focusing on managing the disposal of waste packaging materials. Stage 2 (mid-1980s–early 1990s): The 3R1D principle-Reduce, Reuse, Recycle, and Degradable-later expanded into the 4R1D principle by adding Recovery (energy recovery) [6]. Stage 3 (mid-to-late 1990s): The LCA (Life Cycle Assessment) approach, which evaluates the total resource and energy consumption and environmental impact (carbon footprint) of packaging throughout its entire life cycle-from cradle to grave-including production, storage, logistics, sales, usage, recycling, and disposal [7].

At present, academia has formulated four interrelated concepts related to green packaging development: green packaging, low-carbon

packaging, ecological packaging, and sustainable packaging. The distinctions and interconnections among these four concepts are illustrated in Figure 17. Fundamentally, regardless of whether they are referred to as

green packaging, low-carbon packaging, or ecological packaging, their common objective is to advance the sustainable development of humanity and the environment—that is, to achieve sustainable packaging.

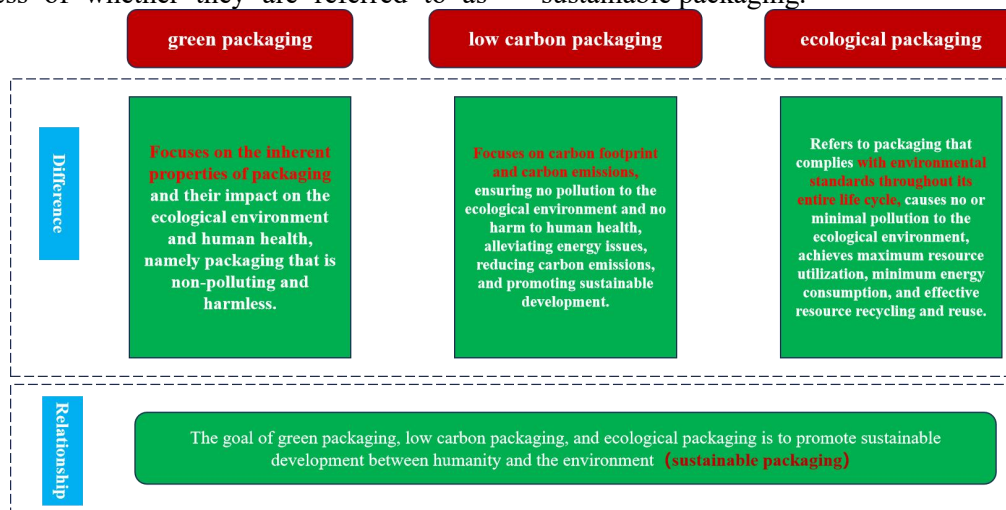


Figure 17. The Distinctions and Interconnections among Four Concepts Related to Green Packaging Development

Under the national “Dual Carbon Strategy” of carbon peaking and carbon neutrality, the sustainable development of the packaging industry has become the dominant theme of the era. The China Packaging Industry Development Plan (2021–2025) also identifies the “Sustainable Packaging Strategy” as a key strategic direction for the industry’s long-term growth. In response, the author introduces a sustainable packaging design concept known as the “Four Can, Five Reduce, and One Enhance” principle, as illustrated in Figure 18. Four Can:

reusable, recyclable, compostable/degradable, and edible. Five Reduce: reduce weight, reduce material use, reduce space, reduce emissions, and reduce plastic. One Enhance: enhance consumer experience. Following the “Four Can, Five Reduce, and One Enhance” principle, sustainable development in packaging can be achieved through design (structure, shape, graphics, and decoration), material selection, process innovation, production and logistics management, and waste treatment.

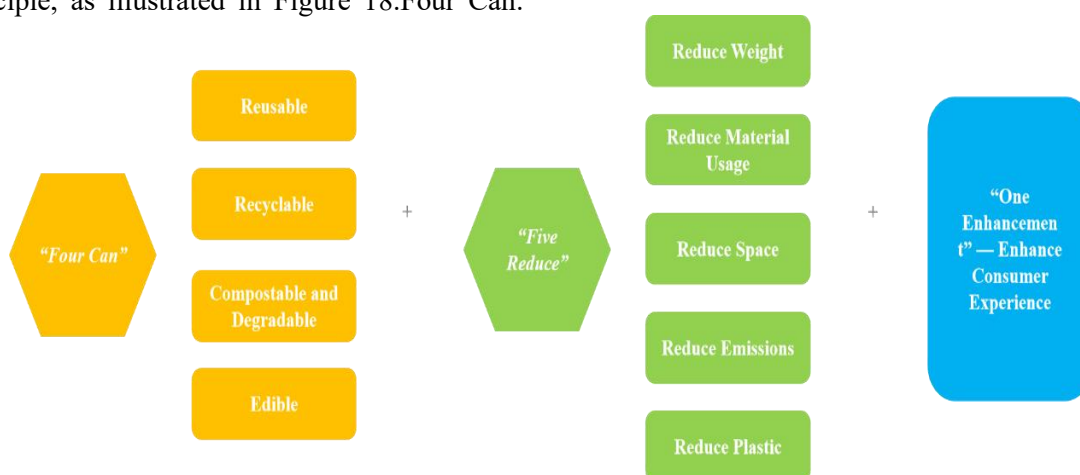


Figure 18. The “Four Can, Five Reduce, and One Enhance” Sustainable Packaging Design Concept

The following example illustrates sustainable packaging design. Figure 19 presents the SOLAR MEDIA reusable packaging. The overall packaging design features a compact

structure that accommodates a solar panel, a screen, three sets of energy-saving lamps, and other accessories within a corrugated paper box the size of a drawer. After removing the lamps

and devices, the original package transforms into a functional drawer, and the partitions originally used to separate different components can be easily torn and folded into several clothes hangers of different sizes.



Figure 19. SOLAR MEDIA Reusable Packaging

3.7 Packaging and Technology

Packaging is an interdisciplinary field that integrates knowledge from multiple disciplines,

including arts, design, mathematics, physics (including mechanics), chemistry, biology, light industry technology and engineering (packaging engineering, printing engineering), materials science and engineering, mechanical engineering, control science and engineering, optical engineering, information and communication engineering, computer science and technology, electronic science and technology, and environmental and resource studies.

As shown in Figure 20, the complete process of packaging planning, design, and manufacturing involves a tightly connected system. A visually appealing and well-functioning packaging product-from design conception to realization-depends on the support of diverse packaging materials, production processes (including packaging printing and post-press processing), and advanced equipment.

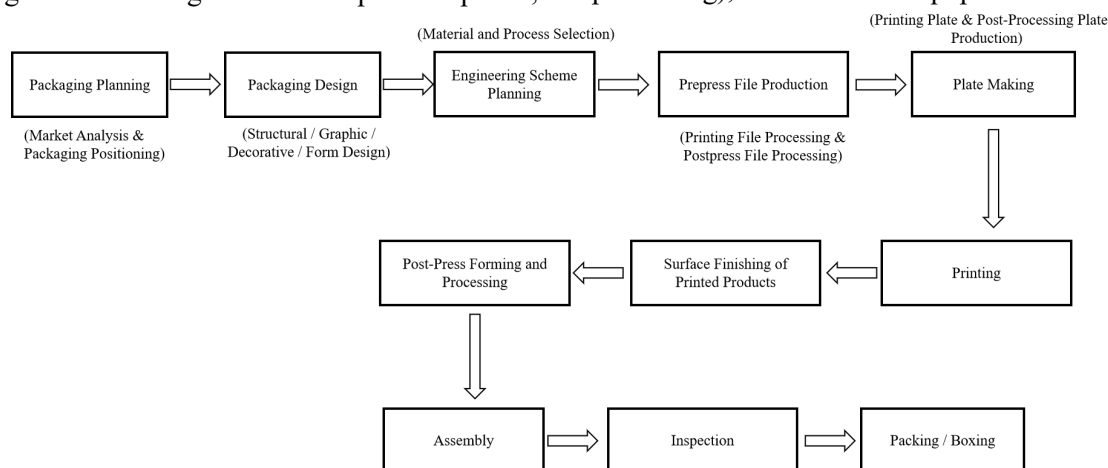


Figure 20. Full Process of Packaging Planning, Design, and Manufacturing

In recent years, based on traditional packaging materials and driven by cross-disciplinary innovation, a variety of new green packaging materials (e.g., biodegradable materials, molded plant fiber materials, and eco-friendly printing substrates and auxiliaries) and functional packaging materials have been developed. These include materials with naked-eye 3D display, anti-counterfeiting, high barrier, freshness preservation, antibacterial and anti-mold, hydrophobic and oleophobic, adsorption, anti-rust, anti-fog, anti-static, electromagnetic shielding, high-temperature resistance, flame-retardant, cushioning, and shape-memory functions. These materials not only meet the needs of green transformation and sustainable development in the packaging industry but also compensate for performance limitations of traditional materials, expanding their applicability and scope.

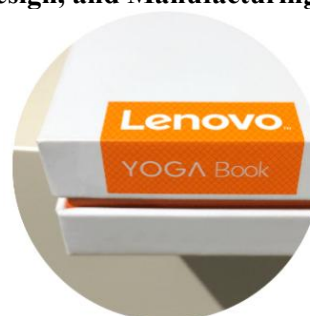


Figure 21. Application of Microlens 3D Display Functional Film Materials in Packaging

For example, Figure 21 demonstrates the application of microlens 3D functional film in consumer electronics packaging [8]. Furthermore, the rapid development of next-generation information technologies-such as the Internet of Things (IOT), Industrial Internet, big data, cloud computing, digital twins, blockchain, 5G/6G, AR/VR, and especially

generative artificial intelligence (AIGC)-has already exerted a profound influence on both the design and manufacturing ends of the packaging industry [9]. In August 2023, Elephant Smart Integration (Xiaoxiang Zhihe) launched ELEAI, the world's first generative AI design system specifically for the packaging industry. By learning from a vast database of professional packaging works, ELEAI has developed unique "aesthetic" and "creative logic" capabilities. It can simulate human thinking, automatically identify product category features, intelligently combine visual elements, and generate innovative packaging design proposals autonomously.

3.8 Packaging and the Supply Chain/Industry Chain

Taking the paper packaging industry as an

example, its complete industrial chain comprises upstream suppliers (upstream), the paper packaging industry itself (midstream), and downstream customers (downstream). The upstream segment includes industries such as papermaking industry, ink production, other auxiliary material industries (e.g., hot stamping foil, pre-coated films, varnishes), and packaging/printing machinery manufacturing. The midstream segment involves packaging product planning, design, and manufacturing enterprises. The downstream segment covers end-user industries such as consumer electronics, tobacco and alcohol, cosmetics, food and beverages, daily chemicals, medical and healthcare products, e-commerce logistics, home appliances, and jewelry, as illustrated in Figure 22.

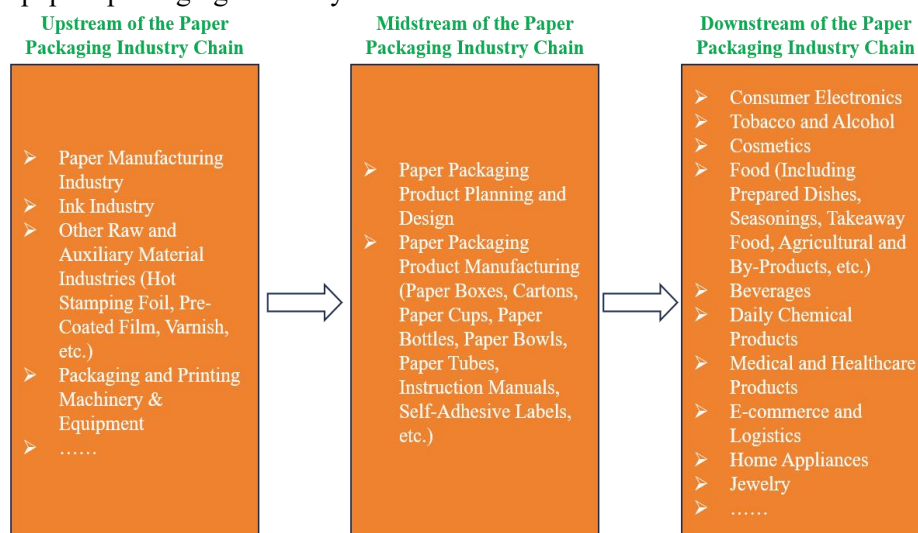


Figure 22. Supply Chain/Industry Chain of the Paper Packaging Industry

The packaging industry represents a complex and lengthy system engineering process, spans multiple stages-packaging planning, design (structure, form, graphics, and decoration), production and manufacturing (materials, printing, post-press processing, equipment), testing, logistics (storage, transportation, sales, use), waste treatment, and recycling. However, traditional packaging products mainly fulfill the basic roles of protection, convenience in transport, and simple promotional functions, positioning them at the lowest value tier within the supply and industrial chain. Combined with the low integration level of China's packaging industry, this results in homogeneity, low-level competition, price wars, and severe overcapacity. The diversity of packaging materials, products, and equipment-combined with inconsistent

standards and uneven technological levels-further complicates the situation. Meanwhile, brand owners increasingly demand faster delivery and lower procurement costs, which puts substantial pressure on packaging enterprises to reduce costs, increase efficiency, improve quality, and reduce inventory.

Thus, the key challenges currently facing domestic packaging enterprises include: How to leverage new-generation information and high-tech technologies to reduce costs, increase efficiency, improve quality, and reduce inventory. How to enhance packaging's added value and elevate its role within the supply and industrial chains. How to address the challenges of green transformation and drive sustainable industry development.

The author proposes three feasible pathways for

addressing these challenges:

(1) By digitizing and upgrading packaging through next-generation information technologies (such as artificial intelligence, IOT, industrial internet, big data, cloud computing, digital twin, blockchain, 5G/6G, AR/VR, etc.), we can empower packaging design, packaging

manufacturing, and packaging products, achieving intelligent packaging design (mentioned in the section on the relationship between packaging and technology), intelligent packaging manufacturing, and intelligent packaging products.

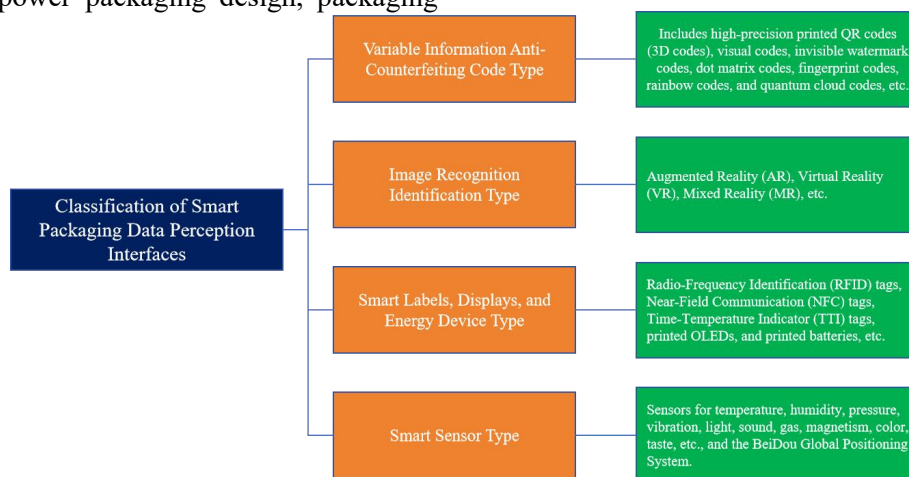


Figure 23. Classification of Smart Packaging Data Perception Interfaces

Among them, information-based intelligent packaging uses traditional packaging as its carrier and smart data perception interfaces as its enabler. These include variable information anti-counterfeiting codes, image recognition identifiers, smart tags/displays/power devices, and smart sensors, as shown in Figure 23. Such systems enhance human-machine interaction and connect packaging with the mobile Internet and IOT, enabling data collection, processing, and utilization throughout the product's full life cycle—from raw materials, production, warehousing, and logistics to sales and consumption. This endows packaging with capabilities such as sensing, interaction, identification, detection, recording, tracking, communication, and logical analysis, expanding its value in product protection, anti-counterfeiting, traceability, smart warehousing/logistics, cross-media marketing, consumer engagement, brand communication, big data analysis, new retail, and supply chain innovation management [10].

(2) Innovative structural design to extend the packaging's life cycle and improve its recycling value, thereby increasing its value and role within the supply and industrial chain.

(3) Reforming traditional manufacturing processes to shorten production cycles and achieve cost reduction, efficiency improvement, and quality enhancement. Two promising directions under this approach include: The

development and application of integrated molded plant fiber packaging solutions; the development and application of recyclable and re-moldable paper-based packaging materials. The latter represents a cross-innovation of new materials, new processes, and new equipment. Key technical challenges include: Developing moldable paper materials through plant fiber modification to give paper plastic-like forming properties; Developing special functional inks that volatilize rapidly under heat or specific light wavelengths, enabling reprocessing of paper packaging without traditional deinking or pulping stages.

3.9 Packaging and Culture/Art

Packaging is an interdisciplinary field that embodies the integration of art and technology as well as design and engineering. It is not only a protective “outer garment” for products but also a carrier of cultural and artistic expression. Through its design language, use of color, graphical elements, choice of materials, and craftsmanship, packaging conveys specific cultural concepts, aesthetic tastes, and artistic styles. In doing so, it becomes an important bridge that connects products with consumers on an emotional level, while also fostering cultural exchange and heritage transmission. Elements of Chinese traditional culture—such as the twelve zodiac animals, the twenty-four solar terms, traditional festivals, ancient architecture,

traditional opera, classical literature, and traditional clothing-as well as regional cultures, contemporary trends, global multiculturalism, and corporate cultures are artistically expressed through text, graphics, imagery, color, form, structure, and material selection in packaging design. This endows packaging with a unique artistic charm and cultural value.

The twelve zodiac animals, as enduring symbols of folk tradition, represent an essential component of Chinese cultural heritage. Throughout history, countless poems, couplets, paintings, calligraphy works, and folk crafts have depicted and celebrated the imagery and symbolic meanings of the zodiac. Figure 24 illustrates the application of zodiac woodblock prints in beer packaging design.



Figure 24. Application of Zodiac Woodblock Prints in Beer Packaging Design

Calligraphy, a visual art form centered on the aesthetic expression of written characters, has long been an integral element of Chinese culture and has profoundly influenced neighboring traditions, including Mongolian, Arabic, and English calligraphic practices. As a distinct Han Chinese art form, Chinese calligraphy is celebrated as "poetry without words, dance without motion, painting without image, and music without sound." Figure 25 illustrates the integration of seal script calligraphy and zodiac motifs in gift packaging design.



Figure 25. Application of Seal Script Calligraphy and Zodiac Imagery in Gift Packaging Design

3.10 Packaging and the Future

As previously noted, following over four decades of development, China's packaging industry has established a relatively comprehensive system encompassing the entire product life cycle, from design, production, and testing to circulation and recycling. The industry is categorized into three primary segments: packaging materials, packaging products, and packaging equipment, and comprises five sub-industries: paper packaging, plastic packaging, metal packaging, glass and ceramic packaging, and bamboo and wood packaging. Under the broader context of cultural confidence, China is witnessing the rise of more domestic and "Guochao" (national trend) brands across various sectors-clothing, food, housing, transportation, entertainment, and social interaction-to meet the growing demands for a better quality of life. This surge will generate a tremendous demand for packaging. By the end of the 14th Five-Year Plan period, China's total packaging industry output value is projected to exceed 3 trillion RMB, accounting for approximately 2.5% of the national GDP. Thus, the packaging industry is a sunrise sector characterized by a vast market scale, diverse application demands, and broad development prospects.

However, in the process of promoting the industry's "Four Transformations"-digitalization, intelligence, greening, and integration-toward sustainable development, there remain numerous technological bottlenecks and key common challenges related to new materials, new processes, and new equipment that must be studied and overcome. Addressing these challenges requires a large number of specialized, innovative, and cross-disciplinary professionals who are committed to advancing the packaging field. The critical question, therefore, is: What specialized and interdisciplinary talent should be cultivated, and how should they be trained? This has become an urgent and epochal mission facing China's packaging education community today.

4. Conclusion

This paper presents an in-depth analysis of the Ten Relationships of Packaging: Packaging and History, Packaging and Products, Packaging and Users/Consumers, Packaging and Brands, Packaging and Life/Health, Packaging and

Environment, Packaging and Technology, Packaging and the Supply Chain/Industry Chain, Packaging and Culture/Art, and Packaging and the Future. Through this comprehensive exploration, students will develop a systematic and holistic understanding of packaging-its essence and significance-while gaining deeper insights into the current state, trends, opportunities, and challenges facing the packaging industry. This approach enhances students' sense of identity, confidence, and pride in the packaging field, encompassing its industry, profession, and enterprises. Additionally, it stimulates their enthusiasm, motivation, and initiative in learning, thereby providing valuable guidance for their future professional studies and sustainable career development.

Acknowledgments

This paper was supported by the 2023 Guangdong Provincial Higher Vocational Education Teaching Reform Research and Practice Project and the 2022 Teaching Reform Research and Practice Project of the Guangdong Provincial Steering Committee for Light Industry and Textile Majors in Higher Vocational Colleges-“Exploration and Research on the Industry-Education Integration Talent Training Mechanism for the Packaging Planning and Design Major” (Project Numbers: 2023JG031, 2022QGFZ05); the Institute of Intelligent Packaging Manufacturing Innovation, Institute for Economic and Social Development, Shenzhen Polytechnic University (6025310002Q); and the 2023 Heilongjiang Province Philosophy and Social Science Research Planning Project- “Research on the High-Quality Integrated Development of Daur Traditional Villages’ Culture and Tourism from the Perspective of the Experience Economy” (23YSC206).

References

[1] Han, Jinping; Han, Yumei; Yin, Yifan. A

Historical Review of the Development of Packaging Design in China. *Packaging World*, 2010(4): 4.

- [2] National Technical Committee on Packaging Standardization. *Packaging Terminology - Part 1: Basic*: GB/T 4122.1-2008. Beijing: China Standards Press, 2008.
- [3] Sasada, Fumihito. *The Power of 0.2 Seconds in Design*. Japan: Daizhitsu, 2012.
- [4] Wang, Fei. *Research on Coca-Cola's Packaging Marketing in China in the Era of Social Media*. Hainan University, 2023.
- [5] Du, Huanzheng; Song, Shuwei; Lu, Sha. Research on the Logical Framework and Implementation Path for Building a Green Recycling System for Express Packaging in China. *Journal of Jiangnan University (Humanities & Social Sciences Edition)*, 2023, 22(02): 5–17.
- [6] Chen, Fang; Guo, Lichun; Zhao, Hangyuan, et al. The 4R1D Concept of Green Transformation in Packaging and Its Practice in the Dairy Industry. *Packaging Engineering*, 2025, 46(15): 1–13.
- [7] Ren, Shuheng. *A Study on the Carbon Footprint of Express Packaging throughout Its Life Cycle*. Beijing Institute of Graphic Communication, 2024.
- [8] Chen, Linyi. *Research on Naked-Eye 3D Printing Technology Based on Microlens Arrays*. South China University of Technology, 2021.
- [9] Wei, Qun; Tu, Xiaofan. Innovative Pathways for Teaching Reform of the “Packaging Design” Course Empowered by Artificial Intelligence Technology. *Research on Printing and Digital Media Technology*, 2025(03): 193–202.
- [10] Chen, Kefu; Chen, Guangxue. Intelligent Packaging-Current Development, Key Technologies, and Application Prospects. *Journal of Packaging Science and Technology*, 2019, 11(01): 1–17+105.