

AIGC-Driven Research on Innovative Design and Diversified Development of Marine Cultural and Creative Products

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Abstract

In recent years, cultural and creative industries have increasingly moved toward innovation, diversification, and personalization, and the cultural content sector is widely regarded as having the potential to become a key pillar of national economies. Focusing on the product-oriented development of marine cultural content, this study examines how AIGC can facilitate innovative design and diversified development of marine cultural and creative products, thereby enhancing cultural communication and user experience. Methodologically, it combines a literature review and conceptual analysis to clarify definitions, classification standards, and significant challenges of marine cultural and creative products, and employs observation and case studies to identify design content, representational approaches, and personalization strategies. The findings suggest that effective marine cultural and creative products should strike a balance between innovation, practicality, aesthetics, and cultural connotations. To address homogenized forms and shallow cultural expression, AIGC-enabled design iteration can improve efficiency, diversity, and narrative depth. The study further proposes adopting a user-experience-oriented, human-centered design approach and integrating with cultural tourism, education, and digital media to strengthen market fit and support sustainable dissemination.

Keywords: AIGC, marine cultural and creative products, innovative design pathways, diversified development mechanisms, semantic mapping of local culture

1 Introduction

The ocean has a profound and far-reaching impact on human social development and everyday life. Relying on coastal resource endowments and locational conditions, coastal cities have achieved remarkable outcomes in economic growth, educational improvement, and industrial structure optimization by excavating and transforming their geographic advantages; with the continuous improvement of residents' living standards, emerging sectors such as cultural tourism and creative design have shown strong development potential in coastal areas and have gradually formed recognizable regional cultural characteristics [1]. In recent years, the integration between marine cultural and creative products and the marine tourism industry has continued to deepen. Alongside the prosperity of tourism, it has also facilitated the emergence and evolution of marine cultural and creative products. However, from the perspective of existing market supply and scenario-based sales practices, related products are still predominantly concentrated in traditional forms, such as shell carving and sand art. Cultural and creative commodities commonly found in marine museums and oceanariums generally suffer from problems, including single product forms, limited dissemination channels, design languages that have not been updated promptly, and long iteration cycles, making it difficult to adequately respond to contemporary consumers' rising demands for aesthetic experience, interactive expression, and personalization. It can thus be seen that marine cultural and creative products still face pressing practical bottlenecks in design processes, content expression, and output quality.

Against this background, conducting systematic design research on marine cultural and creative products is both necessary and urgent, and its objectives can be summarized in three aspects. First, to serve cultural revitalization and the transformation of regional cultural value. In the context of intensifying global cultural development, the cultural content sector is widely regarded as having significant potential to become a pillar of the national economy. Effectively coupling innovative cultural resources with creative design capabilities has become a key pathway for enhancing organizational and industrial competitiveness. Second, to enhance societal attention to and understanding of marine culture, and further strengthen public comprehension of marine environmental deterioration and marine biodiversity conservation issues, thereby increasing willingness to take action. Third, to respond to transformations in dissemination logic in the intelligent era and the era of significant data, we explore more diversified and innovative promotional approaches to enhance the visibility and communication efficiency of marine cultural and creative products. In particular, the development of AIGC-based generative artificial intelligence provides new technical conditions for the rapid generation of marine cultural content, the expansion and iterative refinement of creative proposals, and cross-media dissemination, making it realistically possible for marine cultural and creative products to shift from "traditional souvenir supply" toward "content-driven, experience-oriented products."

Based on this, this paper explores development ideas and design strategies for marine cultural and creative products by analyzing the uniqueness of marine biological resources and their cultural implications. Case studies show that, on the premise of satisfying basic functionality and practicality, marine cultural and creative products can more fully present humanistic care and artistic aesthetics through human-centered design and aesthetic expression,

and can enhance design efficiency and solution diversity through an AIGC-supported closed-loop mechanism of "generation - screening - iteration - implementation." In terms of methodology, this paper first adopts literature review and conceptual analysis to systematically examine national definitions and classification standards of cultural and creative products, thereby analyzing the current situation and significant problems of marine cultural and creative products, and arguing for the necessity of the research from the perspectives of activating cultural development vitality and enhancing the salience of marine culture; second, it combines observation and case study methods to summarize the design content, design techniques, and personalized design strategies of marine cultural and creative products; finally, through integrative analysis, it systematically summarize their promotion and application modes and concludes, providing theoretical references and practical pathways for the innovative design and diversified development of marine cultural and creative products.

2 Research Background

A. Overview of the Global Cultural and Creative Industries

As a key outcome of economic structure transformation in developed countries, the cultural and creative industries have attracted widespread global attention due to their high value-added and advantages in sustainable development. Their growth rate is typically higher than that of the overall national economy, and they have gradually become a new driving force for global economic development. Accordingly, the cultural and creative industries have been regarded as an important strategic direction in contemporary global economic development and have become a shared choice for industrial planning in many countries [2]. Building on prior studies, this paper systematically reviews the definitions and classification criteria of the cultural and creative industries across countries (Table 1), providing a conceptual basis and structural reference for subsequent research.

From the perspective of structural change, as shown in (Fig. 1), during 2014 - 2022, knowledge/information and advertising accounted for a relatively large share of the overall market; except for publishing, other industrial segments generally exhibited growth trends [6]. This indicates that the cultural and creative industries have continued to expand and have become an important pillar of economic development in multiple countries and regions. Meanwhile, advances in digital technologies have continuously diversified the types of cultural and creative products, with design forms gradually moving toward greater systematization and refinement [6]. In particular, generative artificial intelligence technologies, represented by AIGC, have provided new tools for creative content generation and the iterative development of design solutions, thereby improving design efficiency and expressive diversity, and becoming one of the key driving forces for the future development of the cultural and creative industries.

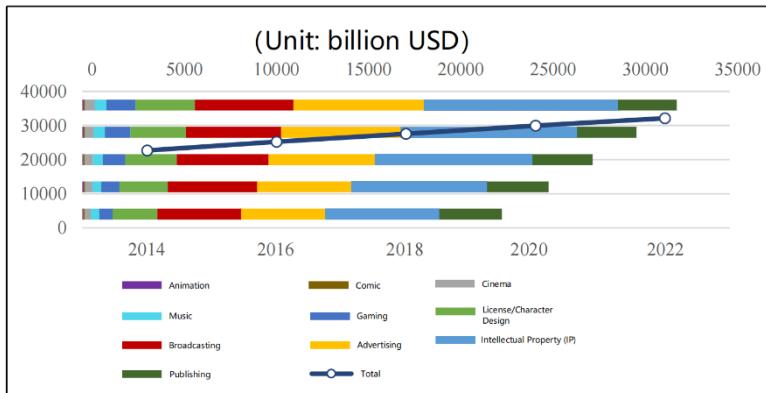


Fig. 1 World Cultural Creative Industries Scale[7]

Table 1. Definition and Classification of Cultural Creative Industries by Country

Country	Industry Name	Definition and Classification
China	Cultural and Creative Industries (CCI)	The Cultural and Creative Industries (CCI) are an emerging sector, originating in the context of economic globalization, with creativity as the core driver. Through the integration of technology, creativity, and industrialization, this sector develops and promotes intellectual property (IP) [4].
United States	Copyright Industries (Copyright Sector)	In the United States, the copyright industries encompass all industries that are based on copyright.
United Kingdom	Creative Industries	Through the creation and exploitation of intellectual property, individual creativity and skills can generate wealth and employment, thereby forming industries [5].
Japan	Creative Industries (Content Industries)	This category covers an integrated set of sectors, including the content industries, leisure industries, and fashion industries.
Korea	Cultural and Creative Industries (Cultural Content Industries)	The cultural content industries (cultural and creative industries) are comprehensive service industries centered on content services. By establishing affective resonance between content producers and consumers, they help individuals attain spiritual liberation and emotional catharsis [3].
Australia	Copyright Industries (Copyright Sector)	This sector primarily produces creative-applied products, which can be distributed through both internet-based and non-internet media channels.
Singapore	Creative Industries	The Creative Industries Working Group (CIWG) largely adopts the UK-style definition.

Against this backdrop, marine cultural and creative products aim to meet human needs and improve the quality of life as their core objectives. The human-centered design philosophy should be adopted as a fundamental principle for research and development. Human-centered design emphasizes

the interactive relationship between products and users. By optimizing functional configurations, simplifying use procedures, and eliminating redundant design, it enhances usability and overall user experience. In the design of marine cultural products, attention should be shifted from marine biological imagery itself to the needs of product users, enabling design responses to the diverse needs of different regions, populations, and occupations. This user-centered shift will become a critical design factor for the in-depth development and diversified innovation of marine cultural and creative products.

A. Concept of Marine Design

- **Marine Design**

Marine design refers to design practices conducted around ocean-related and coastal-region activities, and it can be understood as a specialized form of spatial and systems design centered on the "aquatic environment." As it involves multiple industrial domains such as architecture, manufacturing, and tourism, marine design requires a cross-sectoral and integrative perspective for coordination and synthesis. In this process, design not only undertakes the tasks of form generation and experience optimization but also serves as a bridge and mediator among different stakeholders and industries (Fig. 2) [8].

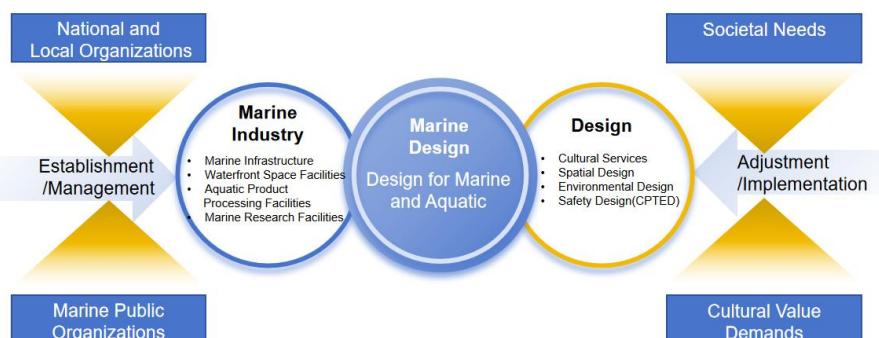


Fig. 2 Concept of Marine Design

- **Characteristics as Natural Resources**

The most prominent feature of marine biological resources is their remarkable biodiversity, which encompasses a rich array of categories and enormous quantities, and constitutes a significant carrier of ecological abundance. The development of marine civilization is closely intertwined with that of human civilization, and the trajectory of social development and modes of economic activity continuously influence the distribution and diversity of marine biological resources. Marine biological resources possess not only aesthetic and recreational value but also scientific research significance and potential for artistic expression, demonstrating a composite resource attribute. Therefore, they can provide important objects for scientific observation and application while also helping the public understand and learn marine knowledge more intuitively.

- **Characteristics as Humanistic and Socioeconomic Resources**

Marine biological resources hold significant value for development and utilization, serving as both an important source of food for humans and a

critical raw material for industrial production. In recent years, with continuous growth in demand for marine biological resources, they have become a vital material foundation closely related to everyday life. Reasonable development of these resources can not only stimulate regional economic growth but may also become an important driver of industrial expansion in the new era. Since the 21st century, along with rising awareness of quality-oriented consumption, demand for marine tourism and marine-themed souvenirs has become increasingly diversified, further expanding the application scenarios and value space of marine biological resources. Accordingly, future development and productization of marine biological resources are expected to generate greater economic and social benefits [9].

3 Case Analysis

Based on the foregoing theoretical analysis, this paper argues that, if supported by innovative technologies, constructing a transformation pathway for marine biological resources that simultaneously integrates "practicality, aesthetics, and knowledge production" will contribute to enhancing the sustainable dissemination of marine cultural content and the inheritance of related resources. To achieve this goal, the study intends to develop more targeted R&D-oriented design thinking and a long-term strategic framework from the perspectives of development concepts for marine biological resources, diversified dissemination channels, as well as information technologies and internet platforms, and to propose actionable implementation plans accordingly. To ensure the practical implementation of these strategies, it is necessary to clarify further the key elements and representational approaches that should be incorporated into the design of marine cultural and creative products.

A. Brand and Product Design

Through field visits to typical venues, such as marine museums and aquariums, this study observes the thematic selection and design expression approaches of existing cultural and creative products, utilizing marine biological elements as core materials and integrating contemporary aesthetic orientations within the traditional context of marine culture. In terms of design strategy, familiar and widely favored marine biological imagery can be effectively integrated with visual styles such as steampunk and flat design; product differentiation can thus be achieved through stylistic reconstruction to meet market demands at different tiers and with varying preferences. Meanwhile, AIGC-based generative technologies can be applied in the early stages for character/image generation, pattern expansion, and rapid iteration of stylistic proposals, providing multi-version creative support for the linkage of "marine elements - brand language - product series," thereby improving design efficiency and expressive diversity.

For the premium consumer market, co-development with well-known domestic and international brands can be adopted, embedding marine biological forms and patterns into categories such as apparel, accessories, and cosmetics to strengthen the artistic attributes of products and enhance brand recognizability [10] (taking luxury fashion products as examples).

- The Louis Vuitton 2021 Summer Marine Collection T-shirts employ bead-embroidery patchwork techniques, featuring sea turtles, seaweed, sharks,

jellyfish, and crabs as primary visual elements; through distinct thematic articulation and visual layering on different base colors, the designs convey a strong marine imagery.

- The Dior 2021 Autumn/Winter "J'ADIOR" series takes marine motifs as its theme, combining cashmere textiles with bead-embroidery craftsmanship in handbag design; by using a deep-blue base color and detailed embellishments, it constructs a refined marine atmosphere and realizes an aesthetic integration of marine biological elements with everyday consumer goods.

For the mass consumer market, practical yet aesthetically appealing marine-themed cultural and creative products can be developed, such as marine-biological creative slogans, drinkware, USB drives, and packaging boxes. These products are relatively cost-effective and frequently used, making them suitable for building stable touchpoints and brand memory through a series-based productization approach (referencing the productization logic of Starbucks' mermaid-logo themed series design).

Table 2. Marine Biological Elements and Global Premium Brands

Brand Name	Marine Biological Elements	Brand Name	Marine Biological Elements	AIGC-Enabled Derivative Creation
Louis Vuitton ocean series	Analytical	J'ADIOR	analytical	

Table 3. Marine Biological Elements and Global Low-priced Brands

Brand name	Logo evolution	Product Design
Starbucks Mermaid-Themed Tumbler Collection	Starbucks Logo Evolution and History: 1971-1987, 1987-1992, 1992-2011, 2011-TODAY	

*Starbucks' green logo features a mermaid-like twin-tailed siren figure.

*The logo was designed in 1971 by the Seattle-based young designer Terry Heckler, drawing inspiration from a medieval woodcut depiction of a sea deity/siren.

B. Creative Product Design

In the innovative design of marine cultural and creative products, integrating digital media with interactive games can transform marine culture from "static display" into "immersive experience." Taking the science-education-oriented children's tablet game "Mindful Ocean" as an example, this application is themed around marine conservation. Users can create artworks based on coloring templates of endangered marine species and, with the support of AIGC/AR, convert two-dimensional works into interactive three-dimensional marine organism avatars, thereby enhancing cognitive understanding of marine biodiversity and strengthening affective connections through the process of "creation-generation-experience." At the same time, its newly introduced AR cleanup gameplay is centered on the task of "collecting virtual plastic bottles," featuring two modes-single-player Little Adventure and multiplayer competitive Ocean Race-and, through "AR Domains," it can transform any physical space into a shared marine-action scenario, enhancing fragmented participation and dissemination scalability. This case indicates that combining AIGC-related capabilities (rapid generation and content expansion) with gamification mechanisms helps promote marine cultural and creative products from a single form of souvenir toward diversified forms of "digital content products + interactive science-education media," while also driving the development of peripheral derivative products and brand-oriented promotion (Fig 3).



Fig. 3 Mindful Ocean Apps

4 Promotion and Application Strategies for Marine Cultural and Creative Products

Field investigations suggest that, as global cultural development and competition within cultural industries intensify, the innovative development of marine cultural and creative products is expected to facilitate further value transformation and diffusion within the marine cultural industry. Centered on marine culture, these products integrate cultural connotations into everyday life scenarios, enabling the public to experience the appeal of marine culture through use. They not only possess practical attributes but also carry cultural expression and educational significance to a certain extent [11].

Since the beginning of the 21st century, the trend toward quality-oriented consumption has driven sustained growth in cultural and creative products. By integrating technological innovation with cultural innovation, it is possible to enhance production efficiency and expressive modes of cultural content, explore more promising industrial pathways, and promote the dissemination and transformation of marine cultural value through "cultural innovation" [11].

In the design of cultural and creative products oriented toward distinctive marine regional characteristics, differentiated expression should be highlighted to establish unique memory points and experiential impressions for consumers. This paper summarizes and categorizes personalized design elements into three key areas: practicality, innovativeness, and locality.

A. Practicality

Although cultural and creative products have become an important form of consumption, homogenization and quality degradation remain evident in marine-themed cultural and creative products, thereby weakening consumers' purchase intentions. The fundamental reason is that some products neglect the service attribute of being "user-centered." Design should comprehensively consider whether a product can provide users with perceivable practical functions, cultural value, and symbolic meaning, while also responding to latent emotional needs and satisfying basic usage requirements. Only by achieving alignment of needs and additive value can marine cultural and creative products develop stable attractiveness and market competitiveness.

B. Innovativeness

Innovativeness can be realized through the introduction of new technologies and new experiences. On the one hand, processes such as 3D printing can enable rapid conversion from digital modelling to physical prototypes and enhance refinement and differentiation through customized production; on the other hand, in the intelligent era, generative technologies such as AIGC can be introduced for image generation, pattern expansion, and iterative development of serialized solutions, improving design efficiency and expressive diversity. Compared with traditional promotional approaches, marine cultural and creative products with interactive and educational attributes are more likely to generate dissemination influence, thereby facilitating the popularization of knowledge related to marine organisms and marine culture.

C. Locality

Coastal cities possess markedly differentiated marine cultural resources. Locality emphasizes establishing stable associations between local cultural symbols and product semantics. By integrating elements such as landmark imagery, historical narratives, lifestyles, and scenario-based experiences, a recognizable expression of urban culture can be formed. Consumers' initial impressions of a product often connect with the local marine culture, thereby strengthening the city's image and cultural memory, and enhancing the dissemination and identification effects of cultural and creative products.

The ocean has a profound influence on human life across multiple dimensions. Integrating cultural innovation with formal innovation and developing marine cultural and creative products through novel concepts, methods, and organizational models is likely to promote rapid development in this field, and also effectively facilitate the dissemination of marine culture. The research conclusions derived from the development and design process of marine cultural and creative products are detailed in Table 4.

Table 4. Development and Design Elements of Marine Culture Creative Products

Personalized design elements	Distinctive features
Creativity and Practicality	<ul style="list-style-type: none">*Leveraging technological innovation to develop more refined and more creatively sophisticated products.*In the design process, fully considering the diverse needs of different target user groups.*Only when products are designed with strong aesthetic appeal can they attract consumers, stimulate consumption, and facilitate transactions.
Aesthetics and Market Demand	<ul style="list-style-type: none">*Given the heterogeneity of consumer needs, product design should emphasize both visual form and alignment with market demand.*While pursuing continuous innovation and development, the marine cultural and creative industry should prioritize deep integration with traditional and diversified industries, thereby laying a solid foundation for future growth.
Integration with Multiple Industries	

With the development of internet technologies and the acceleration of media convergence, promotional approaches for marine cultural and creative products are shifting from offline display toward a dual emphasis on multi-platform dissemination and interactive experiences. Through media formats such as online games and film/television productions, the public can access knowledge about marine organisms and marine culture more conveniently; among these, short-video platforms-characterized by low viewing thresholds, concise content, fragmented dissemination, rapid diffusion, and salient memory cues-better align with users' media consumption habits in the era of media convergence [19]. Building on this foundation, coastal cities and tourist attractions can capitalize on regional market advantages by developing marine cultural and creative brands with high originality and strong recognizability, while integrating scenario-based display with narrative-driven communication; meanwhile, they may draw on mature experiences in IP development and content assetisation, such as Disney's global dissemination through highly original character creation, and the Palace Museum's cultural and creative practice that translates historical and cultural resources into multi-category product lines by transforming stories, figures, and artistic elements into serialized offerings. In the intelligent era, the promotion of marine cultural and creative products can further incorporate generative technologies such as AIGC to rapidly produce and update marine-themed visual content, short-video scripts, and interactive assets, thereby constructing a multi-platform content matrix; combined with online communities and immersive media such as VR/AR, it can form a closed loop of "content production-interactive dissemination - experience conversion," enabling the public to continuously deepen their understanding of marine culture and awareness of marine conservation through participation, sharing, and embodied experience.

5 Conclusion

The ocean continues to shape human life in terms of resource provision, cultural identity, and industrial development. By integrating cultural innovation with formal innovation and introducing generative technologies, such as AIGC, along with new materials and processes, marine cultural and creative products can enhance design efficiency and expressive diversity, while further strengthening the dissemination of marine culture and the

transformation of cultural value. This study argues that high-quality development of marine cultural and creative products requires synergistic advancement in three respects: first, balancing innovativeness and practicality. In response to current problems such as convergent product forms and insufficient articulation of cultural connotations, product experience should be oriented toward user needs by integrating playfulness, knowledge enrichment, and functionality; for children, educational and use value should be strengthened, whereas for adult markets, emphasis should be placed on creative expression and aesthetic differentiation, to increase attention and facilitate purchase conversion through product innovation. Second, coordinating aesthetic value with market fit. Consumption preferences vary across regions and population groups. For this reason, marine cultural and creative design needs to follow a human-centered design philosophy. This design philosophy requires the works to meet the demand for aesthetic expression. Meanwhile, it also asks the design to strengthen contextual adaptability. In addition, improving consumability is another key requirement of this design concept. Third, promoting cross-industry integration and technological synergy. Marine cultural and creative products can be linked with technological domains such as digital media, intelligent interaction, and software platforms, as well as with industries such as cultural tourism and education, to realize sustained innovation and long-term dissemination through a closed loop of "content generation-product development-dissemination and operation-feedback-driven iteration."

At the level of promotion strategies, this study proposes that precise positioning should be conducted around target populations and scenarios, and that marine cultural identity should be enhanced through creative narratives and diversified dissemination methods; under the conditions of media convergence, resources from short-video platforms, social media, and offline scenarios should be integrated to form coordinated multi-platform operations; meanwhile, interactive experiences and timely iteration should be strengthened by leveraging event-based operations, immersive experiences, and AIGC-driven content updating mechanisms to enable rapid renewal of both product forms and cultural content, thereby continuously attracting younger consumer groups and improving market acceptance. Overall, driven by models such as "culture + technology" and "culture + tourism," the marine cultural and creative industry shows potential for further growth and high-quality development. It is expected to expand industrial space and enhance the utilization efficiency of cultural resources through more systematic design methodologies and more effective dissemination mechanisms.

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Abbreviations

PID	proportional-integral-derivative
DC	direct current motor
CDU	current differential unit
CRU	current replication unit
CSU	current squarer unit
TAU	transconductance amplifier unit
CDBA	current differential buffer amplifier
AR	augmented reality
ADC	voltage double closed-loop
RTK	real-time kinematic

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