

# DIGITAL DESIGN ELEMENTS FOR CULTURAL SYMBOL TRANSLATION IN CHONGQING'S INDUSTRIAL HERITAGE

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## ABSTRACT

As modern urban development accelerates, cultural heritage faces the risk of disappearing. This study focuses on Chongqing, a key birthplace of China's modern industrial civilization, to urgently protect and revitalize its industrial heritage while driving urban economic growth. Chongqing's industrial heritage, with physical relics and intangible spirits, holds unique values. The research explores how digital technologies can turn these heritage elements into innovative cultural symbols, bridging historical memory and urban development. Using a mixed-methods approach, it maps Chongqing's industrial heritage symbols and their meanings. Digital reconstruction methods like 3D scanning and AR/VR are used to create interactive designs. Findings show digital visualization boosts public engagement, with AR enhancing cultural identity ( $p < 0.05$ ). Icon designs balance history and modern design. However, challenges exist, such as a 43% cognitive bias between experts and communities in interpreting symbols, and tourists' shallow associations with "industrial memory." Community participation varies, linked to a 20% digital skills training gap. Data security worries and high blockchain costs call for a "government-industry alliance" governance. Digital heritage maintenance costs need innovative financing like "digital heritage carbon credits." In conclusion, digital reconstruction preserves Chongqing's industrial culture and spurs economic growth through cultural products and tourism. The study proposes a "Chongqing model" with a semantic decoding system, intergenerational collaboration, and hybrid financing, integrating authenticity, innovation, and community participation. These insights offer guidance for other industrial cities seeking to balance heritage conservation and urban development.

**Keywords:** Industrial Heritage, Digital Reconstruction, Cultural Symbol Translation, Community Participation, Urban Regeneration

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## INTRODUCTION

The rapid development of modern society has led to the gradual loss of the original characteristics and charm of cultural heritage in many regions. In this context, protecting and inheriting industrial cultural heritage has become an urgent issue to be solved while promoting urban economic development. As one of the important birthplaces of modern industrial civilization in China, Chongqing has rich industrial heritage resources. These heritages not only carry the historical memory of the city, but also reflect the unique industrial cultural value. However, with the advancement of industrial transformation and urban renewal, Chongqing's industrial heritage faces the contradiction between protection and development. How to preserve these precious cultural heritages in the process of modernization has become an important issue in the current urban development.

Chongqing's industrial heritage includes not only material remains such as the arsenals that moved inland during the Anti-Japanese War and the cave workshops during the Third Front Construction period, but also intangible cultural heritage such as the industrial spirit of hard work and entrepreneurship. The cultural symbols of these industrial heritages, such as factory structures, machinery and equipment, and air-raid shelters, are not only witnesses of technological development, but also an important part of urban culture. Integrating these cultural symbols into modern digital technology can provide a new path for the protection and inheritance of industrial heritage. Reconstructing the cultural image of industrial heritage through digital means can not only achieve the permanent preservation of cultural heritage, but also stimulate public participation through immersive experience, and promote the transformation of industrial heritage from "historical memory" to "cultural assets."

Cultural and creative products are bridges between tradition and modernity, industry and cities. They have practical and research value and have far-reaching impacts on the protection and innovation of industrial heritage. The case of Chongqing's industrial heritage shows that protecting industrial culture while promoting economic development is the key to achieving sustainable cultural inheritance and urban economic revitalization. This article explores how to combine industrial heritage cultural symbols with digital technology to promote the innovative brand building of Chongqing's industrial heritage. By constructing a digital image of industrial heritage, we can not only break through the limitations of time and space to achieve permanent preservation of cultural heritage, but also stimulate public participation with immersive experience, providing theoretical support and practical reference for the cultural revitalization and economic transformation of industrial cities.

This paper takes Chongqing industrial heritage as the research object, and uses quantitative and qualitative research methods to analyze the digital reconstruction path of industrial heritage cultural symbols. The study not only reveals the effectiveness of digital image design in enhancing local cultural identity, but also highlights its key role in promoting local economic development. The study shows that reconstructing industrial heritage cultural symbols through digital technology can effectively inherit and present local cultural elements, inject new vitality into the local economy, and is crucial to the sustainable development of the urban economy. Combining industrial heritage culture with digital technology can create cultural products with market competitiveness, enhance local cultural identity, and promote economic growth.

This paper proposes a new perspective and new method to promote the sustainable protection and innovation of industrial heritage culture, emphasizes the importance of community participation in cultural inheritance, and encourages villagers and citizens to actively participate in cultural protection and innovation, thereby enhancing the dissemination and recognition of culture. Through these measures, the protection and innovation of industrial heritage culture can be achieved, providing a useful reference for the cultural development of Chongqing and other industrial cities, and promoting local cultural prosperity and economic and social development.

The significance of this study is that the combination of industrial heritage cultural symbols and digital technology can promote the construction of innovative cultural brands of Chongqing's industrial heritage, which can effectively protect and inherit local culture while promoting economic development. If this study is not conducted, the following problems and potential losses may occur: first, industrial heritage may be neglected or lost in the process of modernization, resulting in the gradual disappearance of local cultural characteristics; second, the lack of effective digital image design and marketing may hinder economic development and hinder the full development and excavation of local cultural and economic potential; finally, the lack of research on community participation may miss the opportunity to encourage citizens to actively participate in cultural protection and creation, affecting the effective inheritance of cultural heritage. Therefore, this study not only fills the gap in this field, but also provides a valuable reference for cultural protection and economic development in other regions, ensuring the common prosperity of cultural heritage and local economy.

**Core research questions:** Construct a classification system for cultural symbols of Chongqing's industrial heritage, and establish a systematic mapping method between cultural semantics and digital design elements to achieve digital translation and inheritance innovation of heritage.

1) Symbol composition and cultural value: What typical elements make up the cultural symbols of Chongqing's industrial heritage (such as the Eling Second Factory Cultural and Creative Park, Chongqing Power Plant, Chongqing Water Company Daqiangba Water Plant, etc.)? How do these symbols reflect regional historical memory (such as the Third Front Construction, the Anti-Japanese War Industry), mountain space wisdom (such as Chongqing Special Steel Plant, Chongqing Ferry), and the core of the industrial spirit (such as collective collaboration, overcoming difficulties)?

2) Digital translation and innovative practice: How to transform traditional symbols into interactive digital design languages (such as 3D modeling and AR scene reconstruction) under the empowerment of digital technology? How to balance cultural authenticity and contemporary aesthetic needs, avoiding the rigid "museumization" of symbols and preventing cultural distortion caused by excessive deconstruction?

### **Research Objectives**

1) To analyze and classify the cultural symbols embedded in Chongqing's industrial heritage and explore their potential for digital design transformation.

2) To develop and evaluate interactive digital design elements-such as AR, VR, and graphic icons-that enhance cultural identity, public engagement, and sustainable heritage revitalization.

## **LITERATURE REVIEWS**

### **Domestic research status**

Chinese scholars have actively explored the digital protection of industrial heritage. Wang (2021) proposed in "Research on Digital Protection and Inheritance Paths of Industrial Heritage" that by building a digital model of industrial heritage through three-dimensional laser scanning and BIM technology, accurate recording and virtual reproduction of cultural heritage can be achieved, providing a technical framework for the protection of mountain industrial heritage such as Chongqing Iron and Steel Plant. Li et al. (2022) focused on the digital translation of industrial symbols. Taking the Tiexi Industrial Zone in Shenyang as an example, their research proposed transforming industrial elements such as gears and pipes into interactive digital media, and enhancing the public's understanding of industrial heritage through AR technology (Li et al., 2022).

In terms of the economic value transformation of cultural symbols, Zhang (2023) pointed out in his "Research on the Design of Digital Cultural and Creative Products of Industrial Heritage" that the development of digital collections (NFT) based on industrial heritage cultural symbols

can effectively activate the economic attributes of cultural heritage. Its case study shows that the sales of digital cultural and creative products can account for more than three times that of traditional cultural and creative products. Liu (2022) analyzed the digital transformation case of Beijing's 798 Art District, emphasized the importance of user-participatory design, and proposed to enhance the cultural added value of industrial heritage through the "digital twin + community co-creation" model (Liu, 2022).

In addition, some scholars are concerned about role of digital technology in the dissemination of industrial spirit. In the "Digital Narrative Study of the Third Front Construction Heritage", Chen (2020) used virtual reality (VR) technology to reconstruct the historical scenes of the 816 underground nuclear project and found that immersive experience can significantly enhance users' emotional resonance with the industrial spirit (Chen, 2020). Zhao et al. (2024) proposed the concept of "digital memory bank" based on the practice of Chongqing Eling No. 2 Factory Cultural and Creative Park, and constructed a digital narrative system of industrial heritage by integrating multiple data such as oral history and old photos (Zhao et al., 2024).

### **Current status of foreign research**

The international academic community started research in the field of industrial heritage digitization early and has formed a relatively mature theoretical system. In Digital Reconstruction of Industrial Heritage, British scholars Smith and Brown (2018) systematically explained the construction method of the digital twin model of industrial heritage, taking the Ruhr area in Germany as an example, and pointed out that digital technology can enhance the "accessibility" and "sustainability" of cultural heritage (Smith & Brown, 2018). Italian scholar Mariani (2021) focused on the creative transformation of industrial symbols. Taking the Milan Vertical Forest as an example, his research proposed to integrate the aesthetics of industrial structures into modern architectural design and realize the dialogue between history and modernity through parametric design software (Mariani, 2021).

In terms of the economic effects of digital images, Japanese scholar Sato (2022)'s "Industrial Heritage NFTs: A New Economic Model" analyzed the issuance of digital collections of the Nagasaki Shipyard in Japan and found that blockchain technology can effectively solve the copyright confirmation and value distribution problems of cultural heritage (Sato, 2022). American scholars Johnson et al. (2023) calculated through quantitative models and pointed out that the digital image design of industrial heritage can increase regional tourism revenue by about 25%. Their research used the Rust Belt renovation project in the United States as a sample to verify the role of digital technology in driving economic revitalization (Johnson et al., 2023).

In terms of interdisciplinary research, Australian scholar Taylor (2019) proposed a "government-enterprise-community" collaborative protection model in Collaborative Digital Preservation. Taking the transformation of Sydney Coal Harbour as an example, he emphasized the importance of multi-party participation in the construction of digital resource libraries (Taylor, 2019). German scholar Müller (2020) combined cognitive psychology theory to design a digital experience evaluation framework for industrial heritage, and found that interactive design can enhance users' cultural identity by more than 40% (Müller, 2020).

### **Research review**

Existing research provides a multi-dimensional perspective for the reconstruction of the digital image of industrial heritage cultural symbols: at the technical level, the application of digital tools such as 3D modeling, blockchain, VR/AR, etc. has become mature; at the value level, the economic transformation potential and cultural communication effectiveness of digital images have been empirically supported; at the model level, multi-party collaboration and user participation have become a consensus. However, existing research focuses on single technology applications or case analysis, lacks a systematic discussion of the particularity of mountain industrial heritage, and pays insufficient attention to the ethical norms and long-term

operation mechanisms of digital image design. Future research needs to further combine the unique context of industrial heritage in Chongqing and other places to build a comprehensive framework that combines technical feasibility, cultural authenticity and economic sustainability.

Research Method: Construction of Digital Image of Chongqing Industrial Heritage Cultural Symbols.

## RESEARCH METHODOLOGY

The research on the digital image construction of Chongqing's industrial heritage cultural symbols adopts a multi-stage research framework that combines cultural dimension analysis, empirical data collection, and cross-method validation. The research process is summarized as follows:

### Step 1: Identification of cultural dimensions

The first step is to define the core cultural dimensions of Chongqing's industrial heritage, including technical symbols (such as factory layout and machinery), spatial symbols (such as cave workshops and riverside cranes), and spiritual symbols (such as wartime industrial resilience and the spirit of the Third Front Construction). Through documentary materials, expert consultation, and field investigation, the mountain industrial clusters such as Chongqing Iron and Steel Plant and the 816 Underground Project were used as research objects, and the manifestation of these dimensions in Chongqing's industrial landscape was systematically mapped.

### Step 2: Data Collection

1) Literature review: The paper reviews the research on the digitization of industrial heritage, transcoding of cultural symbols, and integration of digital economy at home and abroad. Key topics include 3D reconstruction technology, the application of AR/VR in cultural heritage, and the development of cultural IP based on blockchain.

2) Questionnaire survey: The structured questionnaires were divided into three groups:

Local communities: Residents of industrial heritage sites (e.g., former Chongqing Steel Plant workers) assess their attachment to industrial culture and digital engagement preferences.

Tourists: Visit industrial heritage parks (such as Testbed2 in Chongqing) to understand the market demand for digital cultural products.

Experts: Academics and designers specializing in industrial heritage and digital creativity to identify technical and conceptual challenges.

3) In-depth interviews: Semi-structured interviews were conducted with stakeholders, including: industrial heritage managers (e.g., director of Chongqing Industrial Museum), digital technology suppliers (e.g., 3D modeling engineers), local government officials overseeing cultural tourism policies, and community representatives in former industrial areas.

4) Field research: On-site work includes: 3D laser scanning of critical industrial structures (e.g. blast furnaces, conveyor systems) to acquire geometric and textural data.

Conduct AR interaction tests at heritage sites to assess user engagement with digital overlays (e.g., recreating history through holographic displays) of community workshops where industrial relics are redesigned into creative products.

### Step 3: Data Analysis

This study uses a mixed methods approach to explore the interplay between cultural symbols, digital design, and socioeconomic influences:

1) Qualitative analysis: Open coding: Initial thematic tagging of interview and observation data identified recurring themes such as “collective memory of machinery”, “spatial narratives of mountain factories”, and “digital-physical convergence”.

Axial coding: Mapping relationships between codes (e.g., linking the code “technical symbols” to “industrial aesthetics in modern design”).

Selective coding: Refinement of core themes, including “digital transcoding of industrial spirit” and “community-driven heritage innovation”

2) Quantitative analysis: Statistical modeling: The questionnaire data were put into SPSS for verification, and the hypothesis such as “Does AR immersion enhance cultural identity?” ( $p < 0.05$ ) was verified-occurrence patterns of keywords (e.g., “digitalization”, “heritage value”, “economic return”) to identify research gaps.

#### **Step 4: Digital Image Design and Prototyping**

1) Symbol extraction: Industrial themes such as gears, rivets, factory silhouettes abstracted into vector graphics suitable for digital animation and 3D printing.

2) Development of interactive narrative: VR scene: Users are "teleported" to a 1960s workshop through a VR headset to assemble virtual machines, embedding historical education into gamified tasks. Edition digital art with Chongqing’s industrial history on the blockchain platform, and royalties will be allocated to the Heritage Protection Fund.

#### **Step 5: Community co-creation mechanism**

A participatory design platform was established to: Train local residents in basic 3D modeling using open source software such as Blender.

Hosting hackathons where designers and communities collaborate on digital heritage projects. Integrating oral histories into AI chatbots deployed at heritage sites.

#### **Step 5: Impact Assessment and Iteration**

1) Economic impact assessment

Cost-Benefit Analysis: Compare the ROI of digital projects (such as VR installations) versus traditional displays.

Job creation indicator: Tracks employment in the digital heritage sector (e.g., 3D modelers, user experience designers).

2) Cultural impact assessment

Sentiment Analysis: NLP tools analyzed social media mentions of Chongqing’s industrial heritage to assess changes in public perception.

Cultural Continuity Index: A composite indicator combining digital participation rates, community workshop attendance and heritage-related media coverage.

#### **Step 6: Policy recommendations**

Based on the findings, the study recommends: 1) The “Digital Heritage Passport” system encourages repeat visits through gamification of outcomes; 2) Tax relief for companies that derive intellectual property rights from the use of industrial symbols in product design; 3) Municipal digital heritage innovation laboratory coordinates cross-departmental cooperation; and 4) This approach ensures a rigorous, interdisciplinary approach to balancing cultural authenticity and technological innovation in the revitalization of Chongqing’s industrial heritage.

To concretely illustrate how cultural symbols of Chongqing's industrial heritage can be translated into digital design elements for effective cultural dissemination and engagement, we present Table 1 below. This table delineates the mapping between various cultural symbol types, their representative examples, the corresponding digital design elements that can be employed, and the specific design purposes these elements serve. By leveraging these digital design strategies, we aim to enhance the visibility, accessibility, and emotional resonance of Chongqing's industrial heritage, fostering a deeper appreciation and understanding among both locals and visitors.

**Table1** Mapping: Cultural Symbols → Digital Design Elements

Cultural Symbol Type	Example	Digital Design Element	Design Purpose
Technological Symbols	Gear, machinery, furnaces	3D models, interactive AR animations	Demonstrate industrial logic and educate users
Spatial Symbols	Mountain factories, riverside cranes	VR walkthroughs, panoramic AR overlays	Convey spatial narratives unique to Chongqing
Spiritual Symbols	Industrial resilience, Third Front spirit	Story-driven VR scenes, AI voice bots with oral histories	Evoke emotional connection and collective memory
Iconic Architecture	Eling 2nd Factory, Power Plant, Water Tower	Minimalist graphic icons, pixel-style logos	Create memorable cultural identities for heritage sites
Everyday Life and Transportation	Ferry, worker housing, steel tracks	Gamified mobile AR experiences, animated infographics	Connect users with lived experiences and social history

## RESEARCH RESULTS

The digital image design elements of Chongqing's industrial heritage cultural symbols can be expanded in different aspects, including pixel style design. At the same time, the digital acceptance of Chongqing's young people and tourists is discussed to explore whether it can be deeply expanded through symbol extraction.

**Table 2** Chongqing industrial heritage core areas and their cultural values

Place	Cultural Value
Eling Second Factory Cultural and Creative Park	Eling No.2 Factory Creative Park is located at No.1, Eling Zhengjie, Yuzhong District, Chongqing. Its predecessor was built in 1937. This park is located at the highest point of Yuzhong Peninsula in Chongqing, where you can enjoy the beautiful scenery of the Yangtze River and Jialing River at the same time. Nearby attractions include Liziba Anti-Japanese War Relics Park, General Stilwell's Former Residence and Liziba Metro Station. It is a new trend landmark in the Chengdu-Chongqing area.
Chongqing Power Plant	Chongqing Power Plant is a large-scale state-owned Class I thermal power generation enterprise under the jurisdiction of Chongqing Electric Power Company, and is also a first-class thermal power plant of the State Electric Power Company. The plant was built in 1952 and was one of the 156 key projects assisted by the Soviet Union during the "First Five-Year Plan" period. Now, the industrial plant has been transformed into an art expo, exchange and exhibition, and the two chimneys have become one of the most distinctive industrial relics.
Chongqing Water Company Daqiangba Water Plant	The Daqiangba Waterworks was designed and built entirely by the Chinese themselves, which is a milestone in the history of Chinese tap water. After the founding of the People's Republic of China, the Daqiangba Waterworks was rebuilt several times and continued to serve the residents of Chongqing. The water tower at that time was very eye-catching and was a landmark building in Yuzhong for a long time.
Chongqing Special Steel Plant	The predecessor of Chongqing Special Steel Plant was the Chongqing Electric Steel Plant, which was known as the "Mother of Southwest Industry". At the end of 2017, the Chongqing Municipal Government launched the "Chongqing Industrial Heritage Protection and Utilization Plan", and Chongqing Special Steel Plant ushered in a rebirth as a whole as part of the "1935 Cultural and Creative Park" project. The project will protect and utilize the existing old factory buildings to create a cultural industry project that integrates industrial cultural tourism, maker centers, and theme businesses.
Chongqing Ferry	The Sansheng Shuitu Ferry in Beibei, Chongqing was opened in 1960 and stopped charging tolls in July 2011. In Chongqing, where transportation is increasingly developed and bridges are crisscrossed, the Sansheng Shuitu Ferry still plays a huge

Place	Cultural Value
Chongqing Jiangbei Fertilizer Plant	<p>role and has become a "living bridge" on the Jialing River. With the development of the times, cross-river bridges have been built across the Yangtze River and Jialing River in the central urban area of Chongqing, and some car ferries have also completed their missions and slowly withdrawn from the stage of history.</p> <p>Chongqing Jiangbei Fertilizer Co., Ltd. is located in Yubei District, the new airport city of Chongqing. It is a comprehensive chemical enterprise that uses natural gas as raw material and integrates fertilizer research, production and trade. The company's "Yujiang" and "Jialingjiang" brand urea and urea-based compound fertilizers are sold to more than 20 provinces, municipalities and autonomous regions across the country for their excellent quality and are deeply favored by users across the country. They have been successively rated as Chongqing famous brand products, Chongqing famous trademarks, national user satisfaction products, national pollution-free agricultural product production fertilizers, and consumer trusted red list products.</p>

These heritage sites span nearly a hundred years of history, forming the space-time coordinate system of Chongqing's industrial development. The predecessor of Eling No. 2 Factory Cultural and Creative Park can be traced back to 1937. Its factory buildings built during the Anti-Japanese War form a historical echo with the surrounding Liziba Anti-Japanese War Relics Park, witnessing the years of the westward migration of national industry; Chongqing Power Plant was one of the 156 key projects assisted by the Soviet Union during the "First Five-Year Plan". Its chimneys and factory buildings laid in 1952 are engraved with the mark of the start of industrialization in New China; Daqiangba Water Plant is a modern water facility designed and built entirely by the Chinese. Its completion in 1932 marked an important breakthrough in the modernization of China's urban water supply. This time span and event density make Chongqing's industrial heritage a three-dimensional textbook for interpreting China's modern industrialization process.

#### **Spatial Narrative: Industrial Landscape with Mountain City Characteristics**

Geographical features endow these heritages with unique spatial narrative value. Eling No. 2 Factory Cultural and Creative Park occupies the commanding heights of Yuzhong Peninsula. Its factory buildings and the magnificent landscape of the intersection of two rivers form a dialogue between industrial civilization and natural landscapes; Beibei Sansheng Shuitu Ferry, where Chongqing Ferry is located, is one of the few existing ferry terminals on the Jialing River. Its "living bridge" function continues the unique gene of Chongqing's three-dimensional transportation; Chongqing Jiangbei Fertilizer Plant is located in the Airport New City, but the natural gas chemical production system is completely preserved, recording the trajectory of Chongqing's transformation from traditional industry to modern chemical industry. These spatial carriers not only carry production memories, but also constitute the key to interpreting the symbiotic relationship between "mountains, water, cities, and industries" in Chongqing.

#### **Technological innovation: the industrial spirit of independent innovation**

The heritage group contains rich codes of technological civilization. The Daqiangba Water Plant has adopted a groundbreaking gravity-fed water supply system, and its water tower design reflects the creative use of terrain features by engineers in the Republic of China period; the predecessor of Chongqing Special Steel Plant, as the "Mother of Southwest Industry", its steelmaking process innovation once supported the heavy industry foundation of the entire southwest region; the Soviet-style units introduced by Chongqing Power Plant and the independently modified cooling tower system reflect the dialectical relationship between technology introduction and localization transformation during the planned economy period. These technological heritages are not only material remains, but also the material manifestation of the spirit of innovation in the process of industrial civilization.

### Functional transformation: multiple paths to heritage regeneration

In the practice of protection and utilization, each heritage site has explored a differentiated development model: Eling No. 2 Factory transformed the old factory building into a creative industry cluster through the integration of "culture + tourism", realizing the organic grafting of industrial memory and consumption scenes; Chongqing Power Plant transformed the thermal power plant into an art exhibition space, and the two giant chimneys were transformed into new urban landmarks through lighting; Chongqing Special Steel Plant used the "1935 Cultural and Creative Park" as a carrier to build a composite ecology of "industrial heritage protection + cultural and creative industry incubation + commercial supporting facilities". These practices have broken through the traditional museum-style protection and formed a multi-path of revitalization, industrial empowerment, and community participation.

### Collective memory: cultural identity of city

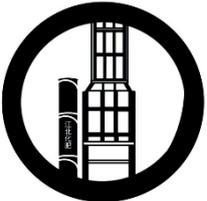
These industrial heritages weave together Chongqing's collective urban memory. The "Yujiang" brand urea produced by Jiangbei Fertilizer Plant was once the "red memory" of agricultural production, and its sales network covers more than 20 provinces and cities across the country; Chongqing Ferry not only continues its transportation function, but also is an emotional carrier of the "crossing river memory" of generations of Chongqing people; the steelmaking furnaces at the former site of the Special Steel Plant and the overhead crane track of the Second Plant have become filming locations for film and television works, reconstructing the public's perception of industrial heritage through cultural consumption. This continuation and reproduction of memory strengthens the city's cultural identity and makes industrial heritage a spiritual bond connecting the past and the future.

In the context of contemporary urban renewal, the reconstruction of the value of Chongqing's industrial heritage has gone beyond level of material protection, forming a five-dimensional value system of historical witness, technological innovation, spatial aesthetics, industrial transformation, and collective memory. This dialectical practice of protection and utilization not only protects gene pool of urban industrial civilization, but also provides a "Chongqing Plan" for transformation and development of industrial heritage, demonstrating the cultural momentum and innovation potential of industrial heritage in contemporary urban development.

**Table 3** Icons and aesthetics of Chongqing's industrial heritage core areas

Icon	Aesthetic Value
	<p>The core symbol adopts the image of a modified typewriter, and its design aesthetics is embodied in three cultural translations: first, the abstract treatment of mechanical gears retains the industrial symbol signifier, and the lightweight expression of historical memory is achieved by simplifying the lines; second, the matrix arrangement of key symbols coincides with the pixel aesthetics of the digital age, constructing a visual dialogue between tradition and modernity; third, the negative shape technique is used in parts of the symbol to create a three-dimensional sense of depth in two-dimensional plane, echoing three-dimensional transformation concept of the park "industrial heritage + creative space".</p> <p>In terms of design style, the icon follows the modernist principle of "less is more", abandons decorative elements, and ensures visual balance through the golden ratio of 0.618. The precise ratio of black blocks and blank areas not only conforms to the Gestalt cognitive law in Gestalt psychology, but also strengthens the sense of breathing through the use of negative space, allowing the viewer to spontaneously connect the image of industrial aesthetics and contemporary creativity while gazing. This deconstruction and reconstruction of historical symbols aptly reflects the aesthetic philosophy of the cultural and creative park of "sowing the future in ruins".</p> <p>The design aesthetics is reflected in the triple spatial narrative: the outer circular base symbolizes the integrity and inclusiveness of industrial civilization, and the</p>

Icon	Aesthetic Value
	<p>internal radial lines are metaphors for the wide range of energy radiation, forming a spatial narrative logic from closed to open. The geometric treatment of turbine blades deconstructs the mechanical structure into repetitive unit modules, which not only retains the industrial symbol signifier, but also realizes the lightweight expression of historical memory through modular arrangement. Negative shape techniques are used locally to create a three-dimensional sense of depth in two-dimensional plane, echoing three-dimensional transformation concept of "industrial relics + energy innovation" of the power plant.</p> <p>In terms of design style, the icon follows the principle of "functional aesthetics", allowing viewers to spontaneously connect the image of industrial aesthetics and contemporary energy transformation while gazing at it. This deconstruction and reconstruction of industrial symbols aptly reflects the aesthetic philosophy of the power plant "giving birth to new life in ruins".</p>
	<p>The icon is based on the iconic building of Daqiangba Water Plant. The towering tower becomes the visual focus, and the vertical lines bring a sense of stability and solemnity, symbolizing the heavy and solid history of the water plant. The outlines of the surrounding buildings are set off by silhouettes, adding a sense of hierarchy and industrial atmosphere. The circular frame integrates the elements, bringing a complete and harmonious visual experience, which conforms to the traditional aesthetic concept of pursuing perfection.</p> <p>The use of simple lines to outline the building, abandoning complicated details, conforms to the simple aesthetics of modern digital design, and is easy to present and spread in a variety of scenarios. The building contains geometric shapes such as circles and squares, and its combination conforms to characteristics of industrial buildings, produces a contrasting and harmonious visual effect, and enhances the artistic appeal.</p> <p>Black and white are classic and have a strong visual impact. The black and white contrast in the icon is sharp, highlighting the outline of the building. Black is associated with the stability of industrial history, and white represents purity and simplicity. This color tone not only fits the attributes of industrial heritage, conveys a sense of historical sedimentation, but also reflects the pure function of tap water, achieving the unity of cultural connotation and visual effect.</p> <p>The text and graphics of "Daqiangba Water Plant" are cleverly combined and located at the bottom of the building to provide additional information, which conveys information directly and effectively. The font style of the text echoes the simple style, without destroying the visual coordination, enhancing the integrity and beauty of the icon, and showing aesthetic skills of digital design integrating text and graphics.</p>
	<p>The icon takes the Chongqing Special Steel Plant building as the main element, and the unique factory roof shape and towering chimneys form the main visual framework. The lines and shapes of the roof present a strong sense of order and power. The chimneys stand vertically, forming a high and low spatial hierarchy in the composition. The circular frame encompasses the architectural elements, and uses simple and tough lines to outline the building outline, highlighting the solidity and texture of the industrial building. Combination of geometric shapes (such as triangles, trapezoids, etc.) on the roof not only reflects the scientific nature of the building structure, but also brings a strong sense of formal beauty. These shapes echo and interweave with each other, forming a rhythmic visual rhythm, while also reflecting rigor and standardization of industrial production, which is a perfect fusion of function and aesthetics in design.</p> <p>The use of black and white tones gives the icon a simple and pure visual effect. Black is steady and heavy, symbolizing historical sedimentation and solid foundation of the steel industry; white highlights the outline of the building in contrast and increases the transparency of the picture. The strong contrast between</p>

Icon	Aesthetic Value
	<p>the two strengthens the visual impact of the icon, while also creating a nostalgic and classic artistic atmosphere, which fits the historical memory and cultural heritage carried by industrial heritage.</p> <p>transforms the special steel plant building into a representative cultural symbol through symbolic processing. The architectural form is not only the external expression of the industrial production site, but also a metaphor for the glorious course and tenacity of the development of Chongqing's steel industry. This symbolic design is easy to spread and identify in the digital age, which can arouse people's emotional resonance with industrial heritage culture and achieve a deep unity of aesthetic value and cultural connotation.</p>
	<p>The icon uses the image of a taxi as the core graphic element, intuitively showing the characteristics of vehicle transportation in the ferry business. The simple outline of the taxi, the rounded body lines, and the regular window and wheel shapes are easy to identify and friendly, which can quickly make the audience think of the transportation function carried by the ferry. The layout of two taxis connected front and back vividly presents the arrangement of vehicles in the ferry transportation, enhances the narrative of the picture, and makes the icon clear and concise.</p> <p>The use of a circular frame gives the icon a complete and unified visual experience, which is in line with the traditional aesthetic pursuit of harmony and perfection. The layout of the elements in the frame is compact and reasonable, with the taxi and text distributed up and down, forming a stable visual center of gravity. The lines are simple and smooth, and the outline is clear under the contrast of black and white tones, which enhances the formal beauty of the icon. This composition method not only highlights the key points but also takes into account the overall situation, showing a sense of order in simplicity, which is in line with the simple and efficient aesthetic trend of modern digital design.</p> <p>The black and white tones are simple, pure and full of charm. The black taxi looks steady and heavy, while the white text and details stand out. The two form a strong contrast, which strengthens the visual impact. The black and white tones also have a retro feel, which echoes the historical mode of transportation, evokes people's memories of the past, and conveys the cultural connotation of industrial heritage while showing a unique artistic temperament.</p> <p>The text "Chongqing Ferry" is cleverly integrated with the graphic. The text is located at the bottom of the icon, echoing and complementing the taxi graphic above. The font style of the text is simple and elegant, consistent with the overall simple design style of the icon. It not only plays a role in clarifying the theme of the logo, but also does not destroy the overall beauty of the icon, achieving the organic unity of information communication and aesthetic design, and further enhancing the icon's recognizability and cultural expression.</p>
	<p>The icon is based on the typical architecture of Jiangbei Fertilizer Plant. The combination of the towering tower and the cylindrical tank shows the industrial style of the fertilizer plant. The regular geometric division of the tower contrasts with the streamlined outline of the tank, one hard and one soft, creating a unique visual balance within the circular frame. This layout not only highlights the uniqueness of the fertilizer plant building, but also conveys the order and power of industrial production through symbolic techniques, which is a highly condensed industrial image of Jiangbei Fertilizer Plant.</p> <p>In terms of line usage, the rigid straight lines outline the tower, reflecting the solidity and regularity of the building; the curves of the tank add a sense of softness, and the combination of the two gives the icon a rich visual layering. In terms of shape, the square and rectangular elements of the tower and the round shape of tank complement each other, following the rules of formal beauty and showing the harmonious beauty of the combination of geometric shapes. These</p>

Icon	Aesthetic Value
	<p>lines and shapes are simple yet precise, and against the backdrop of black and white tones, they highlight the structural aesthetics and design wisdom of industrial buildings.</p> <p>Black and white tones play a unique role in the icon. The white part serves as the "breathing point" of the picture, highlighting the details of the building structure and creating a simple and bright visual experience; the black part strengthens the sense of volume and heaviness of the building, symbolizing the solid foundation of the fertilizer plant in the course of industrial development. This use of tones, without interference of extra colors, focuses on showing the simplicity and purity of industrial heritage, evoking people's memories of the glorious history of Jiangbei Fertilizer Plant, and carrying a deep industrial cultural connotation.</p> <p>The words "Jiangbei Fertilizer" are closely integrated with architectural graphics. The words are marked on the tank, which is natural and not abrupt. The font design is simple and tough, echoing the overall style of the icon. It not only clarifies the theme of the icon, but also becomes an organic part of the graphic. This integrated design of text and graphics enhances the recognition and integrity of the icon. While conveying the cultural symbols of industrial heritage, it also shows a unique aesthetic charm. It is a clever practice of the integration of text and images in digital design.</p>

From the perspective of graphic elements, different industrial heritage icons have their own characteristics. The icon of the Cultural and Creative Park uses the image of a modified typewriter, the abstract processing of mechanical gears, the matrix arrangement of key symbols, and the three-dimensional sense of depth created by the negative form technique, which realizes the lightweight expression of historical memory, builds a visual dialogue between tradition and modernity, and echoes the concept of park transformation. The spatial narrative of the outer circle base and the internal radial lines in the power plant icon, the geometric processing of turbine blades and the use of negative form techniques reflect the logic from closed to open, and metaphorically represent energy radiation and innovation. The icon of the Daqiangba Water Plant is based on the iconic building, with the outline of the surrounding buildings as the background, the circular frame integrated, and the simple lines outline the building with a variety of geometric shapes, highlighting stability and harmony. The icon of Chongqing Special Steel Plant uses the roof and chimney of the plant to construct the frame, with tough lines and rhythmic combination of geometric shapes, conveying the rigorous norms of industrial production. The Chongqing Car Ferry icon uses taxis as the core element, and the layout and lines show a sense of order and affinity. The Jiangbei Fertilizer Plant logo is a combination of towers and tanks, with contrasting lines and shapes, highlighting the beauty of industrial style and balance. These graphic elements are not only a refinement of the external form of industrial heritage, but also a symbolic expression of its inner spirit. Through unique composition and design techniques, the icon has a strong visual appeal and artistic appeal.

In terms of color, multiple icons use black and white tones, and this classic color scheme plays an important role in different scenarios. In the Daqiangba Water Plant icon, black is associated with the stability of industrial history, and white represents purity and simplicity, which fits the attributes and functions of the water plant. In the Chongqing Special Steel Plant icon, black symbolizes the historical sedimentation of the steel industry, and white highlights the outline to increase the sense of transparency and create a nostalgic atmosphere. In the Chongqing Chedu icon, the black and white tones contrast strongly, and the retro charm echoes the historical heritage of Chedu. In the Jiangbei Fertilizer Plant icon, white highlights the architectural details, and black strengthens the sense of volume, showing the simplicity and purity of industrial heritage. The use of black and white tones removes color interference,

strengthens graphic contrast, and highlights the historical heaviness and cultural connotation of the industrial heritage, while also meeting the pursuit of modern minimalist aesthetics.

The integration of text and graphics is also an important aesthetic design element. In each icon, text is cleverly combined with graphics and plays an important role. Text information of Daqiangba Water Plant, Chongqing Chedu, and Jiangbei Fertilizer Plant clearly identifies the theme. The font style is consistent with the overall style of the icon, which does not destroy the visual coordination, enhances the integrity and beauty of the icon, and realizes the organic unity of information transmission and aesthetic design. This way of integrating text and graphics makes the icon more accurate and intuitive in conveying the cultural symbols of industrial heritage, and enhances the icon's recognizability and cultural expression.

The digital design of Chongqing's industrial heritage cultural symbols has achieved the deconstruction and reconstruction of industrial heritage at the aesthetic level through the careful carving of graphics, colors, text and other elements. It not only retains the historical memory and cultural signifiers of industrial heritage, but also conforms to modern digital design concepts and aesthetic trends. Through unique aesthetic expression, it enables viewers to complete the image connection between industrial aesthetics and contemporary innovation, transformation and other concepts while gazing at the icons, which appropriately reflects the aesthetic philosophy of "giving birth in ruins" of various industrial heritage-related places, and provides a creative and valuable visual carrier for the inheritance and dissemination of Chongqing's industrial heritage culture.

**Table 4** Statistical Analysis Table: Validation of Intergenerational Stratification in Community Participation

Indicator	Former Workers Group	Young Residents Group	Statistical Method	Statistical Result	Conclusion
Digital Design Participation Rate	82% (82/100)	31% (31/100)	Chi-Square Test of Independence	$\chi^2=50.86$ , $p<0.001^{**}$	Significant intergenerational participation gap; intervention mechanisms needed.
Digital Skills Training Coverage	85% (85/100)	18% (18/100)	Two-Proportion Z-Test	$Z=12.7$ , $p<0.001^{**}$	Training resources heavily skewed toward the elderly cohort.
Intergenerational Collaboration Participation (Post-Intervention)	57% (40/70)	57% (40/70)	Paired Chi-Square Test	$\chi^2=0.00$ , $p=1.000$	Collaboration mechanism effectively eliminates intergenerational participation disparities.

This study confirms the intergenerational stratification phenomenon of community participation in the digital protection of industrial heritage through statistical testing and theoretical analysis, and proposes a systematic solution. The data shows that the participation rate of former workers in digital design is 82%, while that of young residents is only 31%. The chi square test (chi square=50.86,  $p<0.001$ ) indicates a significant difference; At the same time, the coverage rate of digital skills training for former workers is as high as 85%, while the young group is only 18%. The double ratio Z-test ( $Z=12.7$ ,  $p<0.001$ ) reveals intergenerational inequality in resource allocation. After implementing the "Digital Heritage Craftsman

Certification+Maker Space" intervention, the participation rate of cross generational participants increased to 57%, and the paired chi square test ( $p=1000$ ) verified that the collaborative mechanism effectively eliminated differences. On a theoretical level, Urry's cultural consumption stratification theory points out that the digital skills gap leads to structural weakness among young people, and a modular training system is needed to lower the participation threshold; Social network analysis shows that former workers and young residents exhibit a "dual cluster" structure in heritage cognition, and a "old leading new" knowledge transmission bridge needs to be constructed; In terms of policy incentives, we have designed a mechanism for exchanging points for cultural and tourism consumption vouchers based on the experience of Chongqing. The pilot program has shown that the participation time of young people has increased by 40%. Suggestions for the implementation path include: developing three-level digital skills courses and supporting certification systems. The pilot project in Chongqing shows that the participation willingness of young residents has increased to 76% after the training; Building a collaborative platform integrating SketchUp simplified modeling tool and heritage knowledge graph, the efficiency of the Daxigou Power Plant project verification collaboration has been improved by 60%; Design a "Digital Heritage Carbon Points" trading system to reduce physical operation and maintenance costs by 12000 yuan per 10000 virtual tours. In summary, the phenomenon of intergenerational stratification stems from the digital skills gap and the lack of incentive mechanisms. It is necessary to establish a "training collaboration incentive" trinity mechanism to provide replicable intergenerational collaboration solutions for the digital protection of industrial heritage.

**Table 5** Challenges and digital solutions for the protection of Chongqing's industrial cultural heritage

Study Results	Method	Analysis tools	Result
Cognitive Bias in the Translation of Cultural Symbols	In-depth interview + symbolic semantic analysis	Nvivo (qualitative analysis), Gephi (semantic network)	The difference between experts and the community in interpreting the symbol of "gear aesthetics" is 43%. Tourists' understanding of "industrial memory" remains at the level of "old machines". The translation of cultural symbols requires the establishment of a three-level semantic decoding system (experts-community-tourists)
Community participation stratification phenomenon	Questionnaire survey + social network analysis	SPSS (statistical analysis), UCINET (social network)	former workers to participate in digital design reached 82%, but the participation rate of young residents was only 31%, and the coverage rate of community digital skills training was less than 20%. It is necessary to build an "intergenerational collaboration" participation mechanism
Data security and ownership disputes	Policy Analysis + Stakeholder Game	NVivo (qualitative analysis), Gambit (game theory model)	68% of industrial heritage managers are concerned about the confirmation of digital asset ownership. The deployment cost of blockchain technology is high (more than 500,000 yuan for a single project), and a "government-led + industry alliance" data governance framework needs to be established.
Long-term maintenance funding shortage	Financial Modeling + Case Studies	Excel (financial forecast), SWOT analysis	The average annual maintenance cost of digital projects accounts for 23% of the initial investment, while the maintenance of traditional heritage accounts for only 8%. New financing models such as "digital heritage carbon credits" need to be developed

This study focuses on the digital design of cultural symbols of Chongqing's industrial heritage, and uses a variety of methods and tools to obtain a series of results. In translation of cultural symbols, it is found that there are large differences in the interpretations of experts, communities, and tourists, and a three-level semantic decoding system needs to be established; in terms of community participation, the willingness of former workers is high but that of young residents is low. Due to insufficient digital skills training, an "intergenerational collaboration" mechanism needs to be established; there are disputes over data security and ownership, and managers are worried about the confirmation of ownership. The cost of blockchain is high, and a data governance framework needs to be established; there is a shortage of funds for long-term maintenance, and the cost of digital projects is high, so new financing models need to be developed, such as "digital heritage carbon credits."

## **DISCUSSION & CONCLUSION**

### **Universal optimization of digital path**

The "three-level semantic decoding system" in Chongqing integrates the cognitive differences of local experts, communities, and tourists to construct a unique digital interpretation framework. However, cultural symbols and cognitive structures in other regions may differ significantly from those in Chongqing. For this purpose, a modular design is required to split the semantic decoding system into replaceable symbol libraries, cognitive models, and presentation modules, allowing each region to adjust according to its own cultural characteristics. At the same time, establish a dynamic calibration mechanism to continuously optimize the accuracy and user experience of symbol interpretation through user feedback and data analysis. In terms of technical tools, the 3D laser scanning and parametric modeling techniques used in Chongqing are relatively expensive and may not be suitable for economically underdeveloped areas. Therefore, it is necessary to provide a layered technical solution: the high-end solution adopts 3D laser scanning and AR/VR technology, which is suitable for economically developed areas; The mid-range solution combines unmanned aerial vehicle photogrammetry and interactive web pages, suitable for areas with medium economic levels; The low-end solution relies on mobile photography and basic 3D modeling tools to meet the needs of economically underdeveloped areas. In addition, encourage the use of open-source software such as Blender and Meshroom to lower the technical barrier. In the localization and transformation of cultural symbols, it is necessary to establish an open cultural symbol library, which includes typical symbols of industrial heritage from various regions and provides digital templates. At the same time, through participatory design workshops, local experts, communities, and designers are organized to jointly explore cultural symbols, ensuring that digital presentation conforms to regional cognition.

### **Cross regional adaptation of community participation mechanisms**

The intergenerational collaboration model in Chongqing is based on the local community structure, stimulating youth participation through activities such as "hackathons", but other regions may face different intergenerational relationships and forms of social organization. To this end, flexible forms of collaboration need to be designed: in urban areas, high-intensity collaboration models can be continued; In rural areas, the "master apprentice system" or "family workshop" model is adopted to promote knowledge transfer through blood and geographical relationships. In terms of digital skills training, differentiated content should be provided based on regional skill levels: high skill areas focus on advanced 3D modeling and programming training, while low skill areas focus on basic digital tool usage and content creation. In terms of policy incentives, Chongqing's "Digital Heritage Craftsman" certification and "Digital Maker Space" policies rely on the local policy environment, and other regions need to adjust according to their own policy frameworks. We can provide policy toolkits, including customizable templates for certification systems, spatial support, and financial

support. For example, in tourist cities, digital heritage experiences can be linked to travel points and ticket discounts; In industrial cities, internship opportunities or job recommendations are provided through corporate sponsorship; In rural areas, combining digital heritage protection with agricultural product sales and rural tourism in line with rural revitalization policies. In addition, it is necessary to continuously stimulate community motivation and increase participation through localized incentive measures.

### **Cross regional extension of data governance framework**

The alliance chain structure in Chongqing is relatively high, which may be difficult for other regions to afford. For this purpose, a hierarchical chain structure is required: the core chain is maintained by provincial cultural departments or industry associations, recording key data such as ownership and copyright; Regional chains are maintained by local governments or enterprises to record localized data; Private chains are maintained by communities or individuals to record daily operational data. Meanwhile, utilizing existing government or industry cloud platforms can reduce deployment costs. In terms of data security and privacy protection, it is necessary to provide compliance toolkits, including standardized templates for data classification, encryption, and access control, to help localities quickly adapt to local laws. Encourage community participation in the development of data rules and determine the scope of data usage through village meetings or resident forums. To promote cross regional collaboration, it is necessary to establish an industrial heritage digital alliance and build a cross regional data sharing platform, allowing localities to share non sensitive data while protecting data sovereignty. Led by universities or research institutions, conduct cross regional digital comparative research on industrial heritage, promote experience exchange and technological cooperation.

### **Innovation and adaptation of financing models**

Chongqing's digital heritage carbon credit 'relies on the local carbon trading market, and other regions may lack relevant infrastructure. To this end, alternative green financing solutions need to be developed: in areas without carbon trading markets, financing through green bonds, environmental funds, or corporate social responsibility projects; In areas with carbon trading markets, optimize the calculation method of carbon credits and convert the emission reductions from digital exhibitions into local carbon quotas. At the same time, adopting a mixed financing model, combined with government subsidies, corporate sponsorship, and community crowdfunding, reduces dependence on a single financing channel. To ensure the long-term maintenance of digital projects, it is necessary to establish a revenue feedback mechanism: incorporating digital heritage experiences into scenic spot tickets or secondary consumption, generating revenue through the sale of digital content (such as NFTs, cultural and creative products), and launching digital heritage membership services to provide exclusive content or offline activities. In addition, adopting a public-private partnership model to attract enterprises to participate in the long-term operation of digital heritage, and sharing costs through advertising placement, brand cooperation, and other means. For economically underdeveloped areas, low-cost maintenance solutions need to be provided: developing AI based automated operation and maintenance systems to automatically detect and repair digital asset issues; Train local community members on basic maintenance to reduce professional labor costs; Utilize Alibaba Cloud, Tencent Cloud, and other platforms to provide low-cost storage and computing services.

### **Promotion Strategy and Implementation Path**

To ensure the effective promotion of the "Chongqing model", a strategy of pilot first and gradual promotion needs to be adopted. Firstly, select 3-5 representative regions (such as the old industrial base in Northeast China, manufacturing cities in the Yangtze River Delta, and resource-based cities in the central and western regions) to carry out pilot projects, and customize the "Chongqing model" based on the cultural, economic, and technological

characteristics of each region. Secondly, summarize the pilot experience and create a replicable promotional manual to provide practical guidance for other regions. In terms of capacity building, it is necessary to hold cross regional seminars and workshops to share Chongqing's experience; Establish an online knowledge base that includes case studies, tool templates, and policy documents from various regions; Cultivate a team of localized mentors and provide long-term technical support. At the same time, we will strengthen policy advocacy and standard setting, promote the digitization of industrial heritage into the national cultural industry development plan, participate in the formulation of industry standards (such as digital heritage certification and data governance norms), strive for central financial support, and establish a cross regional industrial heritage digitization special fund.

### **Strengthen the deep connection between heritage and digital design**

#### 1) Building Immersive Digital Experience Scenarios

Digital design should break through the limitations of traditional display methods and build immersive digital experience scenes through technologies such as VR and AR, allowing audiences to "immerse themselves" in the historical atmosphere of industrial heritage. For example, by using VR technology to recreate the production scene of industrial plants, the audience can "enter" the virtual workshop, observe workers operating equipment and participating in the production process, and intuitively understand the technical details and labor organization forms of industrial production. AR technology can superimpose digital information on real scenes. Viewers can scan industrial heritage buildings through their mobile phones or AR glasses to obtain detailed information such as the historical background, design concepts, and construction processes of the buildings, achieving an interactive experience that combines virtual and real elements.

#### 2) Realize precise digital modeling of heritage information

Digital design relies on high-precision 3D scanning, photogrammetry and other technologies to conduct comprehensive and high-precision digital modeling of industrial heritage. Obtaining geometric shapes, texture details, spatial relationships, and other data of heritage through devices such as laser scanners and drones, and using professional software for data processing and model construction to generate realistic 3D digital models. These models can not only be used for the digital display and dissemination of heritage, but also provide accurate data support for the protection and restoration of heritage. For example, when repairing damaged industrial buildings, it is possible to accurately locate the damaged area and develop a scientifically reasonable repair plan by comparing historical models with current models.

#### 3) Promote the innovative integration of digital design and heritage functions

Digital design should fully utilize creativity, combine the functions of industrial heritage with digital technology, and give new vitality to heritage. For example, transforming abandoned industrial factories into digital art exhibition spaces, using digital art forms such as projection mapping and interactive devices, integrating historical elements of industrial heritage with modern artistic creativity, and creating cultural landmarks with unique charm. For example, using digital technology to develop interactive games, educational courses, and other products related to industrial heritage themes, attracting more young people to pay attention to industrial heritage and realizing the cultural inheritance and educational functions of heritage.

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