

“Digital-Physical Integration: A New Chapter for Factory No. 2” — A Survey of the Current Status and Research on Optimization Pathways for the Revitalization of Chongqing’s E’ling Factory No. 2 Industrial Heritage

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Abstract: With the successive introduction of policies related to heritage protection and urban renewal in China, the revitalization of industrial heritage has become a key means of promoting high-quality urban development, preserving historical continuity, and demonstrating cultural confidence. Chongqing E’ling No. 2 Factory (hereinafter referred to as “No. 2 Factory”) was originally the Central Bank’s banknote printing plant during the Republic of China era and was later renamed the Chongqing Printing No. 2 Factory. It stands as a quintessential example of modern and contemporary industrial heritage in Southwest China, embodying rich historical, technological, social, and artistic value. To examine the current state of revitalization, existing challenges, and optimization strategies for this site, this study conducts research focusing on four key stakeholders: the government, the site management, businesses, and consumers. It employs methods such as document analysis, questionnaire surveys, text mining, and face-to-face interviews to collect field data. The collected data is then analyzed using descriptive statistics, K-Means clustering, cross-tabulation, random forest models, and SHAP explanatory methods.

The results show that the revitalization of the No. 2 Factory industrial heritage project has yielded significant results, with commercial vitality steadily increasing. There is broad consensus regarding the project’s historical and cultural value, but there are notable differences between merchants and consumers in their assessments of the preservation of the architectural character. The use of digital and intelligent technologies to create immersive experiences is providing a key innovative impetus for the dynamic revitalization of heritage sites. Different types of merchants and consumers exhibit varying preferences in terms of engagement, satisfaction, and digital and intelligent technology needs. Based on the research findings, we propose multifaceted optimization measures and recommendations from the perspectives of the government, merchants, consumers, and the park management. This paper also employs random forest and explainability analysis methods to supplement empirical research on the revitalization of industrial heritage. We hope these findings will provide valuable references and insights for the future renovation and optimization of the E’ling No. 2 Factory, as well as for the digital and intelligent revitalization of similar industrial heritage sites across China.

Keywords: Chongqing E’ling No. 2 Factory; Revitalization of Industrial Heritage; Digital-Intelligence Integration; K-means Clustering; Random Forest; Revitalization Pathways

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1. Introduction and Literature Review

1.1 Introduction

The “Outline of the 15th Five-Year Plan for National Economic and Social Development of the People’s Republic of China” explicitly states: “We will intensify efforts to protect World Cultural Heritage sites, historical sites and ruins, revolutionary cultural relics, museum collections, and cultural landscapes, and strengthen the effective protection and living heritage of historic and cultural cities, districts, and towns.” The “Opinions on Continuously Advancing Urban Renewal Initiatives” issued by the General Office of the CPC Central Committee and the General Office of the State Council explicitly state: “We encourage the use of market-oriented approaches to promote the renewal and transformation of old industrial sites, strengthen the protection and utilization of industrial heritage, revitalize and utilize idle and underutilized industrial sites, buildings, and facilities, and introduce new business models and functions.” The aforementioned document states that, against the backdrop of policy guidance and contemporary development, the revitalization of industrial heritage has become a key driver for promoting high-quality economic development and enhancing cultural confidence, embodying multiple values including the preservation of historical memory, urban renewal, the continuity of cultural heritage, the revitalization of assets, and the transmission of humanistic spirit.

On the political front, as China’s cultural confidence continues to grow, the revitalization of industrial heritage has gradually become a key means of promoting industrial culture. Projects such as the E’ling No. 2 Factory have flourished against this backdrop. The state has introduced a series of policies, including the *Administrative Measures for National Industrial Heritage*, which provide institutional safeguards and a clear direction for the revitalization and utilization of industrial heritage. From an economic perspective, from 2015 to 2024, the economies of Chongqing Municipality and Yuzhong District maintained steady growth, with a consistently robust consumer market and total retail sales of consumer goods sustaining a growth rate of over 9% for an extended period. At the same time, Yuzhong District has continuously increased its investment in the cultural and tourism industries, providing solid financial and industrial support for the renovation and operation of Erchang. From a social perspective, Factory No. 2 holds significant urban memories and possesses notable cultural value. As living standards rise, people increasingly seek mixed-use spaces that combine historical depth with creative vitality. By revitalizing industrial heritage, we can preserve urban memories while strengthening cultural identity. Technologically, next-generation information technologies such as 5G, big data, AI, and the Internet of Things (IoT) provide tangible support for the revitalization of Factory No. 2. From 2015 to 2024, the number of internet broadband access ports in Chongqing increased by 179.3%, and the number of mobile base stations grew by 402.2%, establishing a “dual-gigabit” network infrastructure. These technological capabilities support applications such as smart guided tours, AR real-world navigation, and VR immersive experiences, driving the transformation of industrial heritage from static relics into dynamic narrative spaces.

1.2 Literature Review

1.2.1 A Study on the Theory and Practice of Industrial Heritage Revitalization

At the theoretical level, scholars have engaged in in-depth discussions regarding the underlying logic and framework for the revitalization of industrial heritage. Lu Zhongzheng et al. (2026) adopting a perspective of cultural regeneration, argue that revitalization efforts should balance the preservation of physical heritage with the reshaping of cultural values. Ma Qing et al (2025) draw on spatial narrative theory to explore design methods for the revitalization of heritage spaces. Wang Jingkai et al (2025) drawing on the concept of urban regeneration, argue that heritage revitalization must proceed in tandem with urban development. Feng Rui (2025) demonstrates, from the perspective of cultural governance, that brand repositioning can effectively promote the revitalization and development of industrial heritage.

At the level of implementation approaches, Zhang Jie (2026) systematically reviewed the diverse models for the revitalization and reuse of industrial heritage and identified development strategies tailored to different contexts. Wang Yue (2026) explored integrated approaches to revitalizing industrial heritage and reshaping urban public spaces. Fang Xiaolong et al (2026) analyzed the regional characteristics and implementation strategies for the revitalization and reuse of industrial architectural heritage. Li Haidong et al (2025) developed a platform model for the preservation and revitalization of ceramic industrial heritage and highlighted the key role of platform-based operations in resource integration and value co-creation. Ren Binbin

et al (2025) conducted a study on the potential assessment and revitalization strategies for industrial heritage in the central urban area of Tianjin, providing methodological guidance for the quantitative evaluation of heritage value. Wang Ruoran et al. (2026) examined the issue of economic sustainability in industrial heritage regeneration from a financial balance perspective, providing an analytical framework for the financial planning of revitalization projects.

1.2.2 A Study on the Revitalization of Industrial Heritage Driven by Digital and Intelligent Technologies

The integration of digital and intelligent technologies with the revitalization of industrial heritage has become a hot topic of research in recent years. Sang Guoguo (2026), approaching the issue from the perspective of digital memory, analyzed the value implications, current challenges, and optimization strategies for the revitalization and utilization of Third-Line industrial heritage. The author specifically emphasized that digital methods can play a unique role in the preservation and dissemination of heritage memory. Liu Lihua et al. (2025) examined how to coordinate and synergize digital empowerment with the integration of culture, commerce, and tourism in the context of industrial heritage conservation and utilization. They proposed an approach that requires focusing on and advancing both technological empowerment and business model innovation.

1.2.3 Regional and Case Studies

Regarding the existing literature, a significant body of empirical research has already been accumulated, primarily focusing on the revitalization of industrial heritage in specific regions and the analysis of typical case studies. In the Southwest region, Wang Jiacui (2025), using Zunyi as a case study, focused on the integration of culture and tourism to explore how urban industrial heritage from the “Third Front” construction era can be revitalized. Qi Yicong et al (2025), adopting a “Third Front” perspective, studied the spatial characteristics and revitalization strategies of industrial heritage in the Chengdu metropolitan area, thereby providing a regional-level perspective on the differentiated utilization of industrial heritage in Southwest China.

Existing research has laid a theoretical foundation for the revitalization of industrial heritage, but certain shortcomings remain: at the theoretical level, existing studies rarely provide a systematic analysis of collaborative governance among multiple stakeholders; in terms of research methods, there is a lack of quantitative measurement and interpretable analysis of results, and multidimensional quantitative research based on field surveys remains insufficient; In terms of research subjects, there is a lack of empirical studies on industrial heritage sites in the form of cultural and creative parks within urban core areas of Southwest China, and the revitalization outcomes of the E'er Factory in E'ling, Chongqing, have not undergone a comprehensive systematic evaluation; in technical research, digital and intelligent technologies are often viewed merely as tools, with few studies incorporating them as influencing factors into the framework for assessing heritage revitalization. Therefore, this paper adopts a multi-stakeholder perspective encompassing government, the park, businesses, and consumers. Combining questionnaire survey data with quantitative methods such as descriptive statistics, K-Means clustering, random forests, and SHAP, it explores the current status, challenges, and optimization pathways for the revitalization of E'ling No. 2 Factory, aiming to provide empirical references for the development of industrial heritage revitalization.

2. Model Development, Metric Selection, and Data Sources

2.1 Model Development:

To systematically evaluate the current status and optimization strategies for the revitalization of the E'ling No. 2 Factory industrial heritage site in E'ling, Chongqing, this paper constructs two analytical frameworks: first, a clustering model based on K-Means clustering; and second, a model for identifying and visualizing influencing factors based on Random Forest and SHAP.

2.1.1 K-Means Clustering

K-Means clustering is an unsupervised partitioning algorithm that divides a set of data into K independent clusters by repeatedly calculating the minimum distance between each sample and the cluster centers. This paper performs K-Means clustering analysis on both merchants and consumers to identify the characteristic differences among different groups, thereby providing a classification framework for the park's differentiated operations. The core formula is:

$$E = \sum_{i=1}^k \sum_{x \in C_i} \|x - u_i\|^2$$

Let E denote the objective function, which is the sum of the squares of the distances from all points to their cluster centers; let k denote the total number of clusters; let C_i denote the i -th cluster; let u_i denote the center of the i -th cluster; and let $\|x - u_i\|^2$ denote the square of the Euclidean distance from the sample point x to the cluster center u_i .

2.1.2 Random Forest Model

Random Forest is an ensemble learning algorithm based on the Bagging method. By constructing multiple decision trees and combining their predictions, it can effectively handle nonlinear relationships among variables and offers good predictive accuracy and resistance to overfitting. The core formula is:

$$\hat{y}(x) = \frac{1}{T} \sum_{t=1}^T h_t(x)$$

Each decision tree $h_t(x)$ in a random forest outputs a prediction. By summing the predictions from all T trees and dividing by T , we obtain the final prediction $\hat{y}(x)$.

2.1.3 SHAP Model

The SHAP method, based on cooperative game theory, quantifies the marginal contribution of each feature to the prediction results while illustrating both the direction and magnitude of the influence. To further reveal the specific mechanisms through which each variable influences consumer type predictions, SHAP was used to perform an interpretive analysis of the random forest model. The core formula is:

$$\phi_i(F, f) = \sum_{S \subseteq F \setminus \{i\}} \frac{|S|!(|F| - |S| - 1)!}{|F|!} [f(S \cup \{i\}) - f(S)]$$

Let F denote the set of all features, and let S denote any subset of features that does not include feature i . The model uses only the features in S to make a prediction, yielding a value $f(S)$. This formula calculates the change in the predicted value before and after adding feature i by considering all possible combinations of features, then computes a weighted sum of these changes to ultimately determine the contribution of feature i to the prediction result.

2.2 Development of an Indicator System

2.2.1 Basis for Selecting Indicators

This study takes into account the multifaceted value dimensions of industrial heritage and ultimately constructs an evaluation index system comprising four dimensions: historical value, technological value, social value, and artistic value. The study focuses on the E'ling No. 2 Factory industrial heritage project in Chongqing. Data were primarily sourced from field survey questionnaires, local statistical yearbooks, and publicly available government data, with missing values imputed using interpolation methods.

2.2.2 Indicator System

This paper selects 16 indicators across four dimensions to construct an evaluation framework for the revitalization of industrial heritage: at the historical value level, the indicators include satisfaction with the preservation of architectural features, satisfaction with the preservation of industrial equipment, overall satisfaction with preservation, and historical recognition; at the technological value level, the indicators include demand for digital and intelligent experiences, utilization rate of digital and intelligent technologies, intensity of investment in digital and intelligent elements, and R&D personnel; For the social value dimension, the following indicators were selected: economic contribution of businesses, per capita consumption multiplier, contribution to the cultural and tourism economy, and population density; for the artistic value dimension, the following indicators were selected: perception of architectural character, integration of cultural and creative industries, willingness to participate in activities, and overall satisfaction with utilization. The composition of specific indicators, data sources, and calculation methods are shown in Table 1 :

Table 1 Evaluation Indicator System for the Revitalization of Industrial Heritage

Dimension	Metrics Layer	Unit	Calculation of Indicators	Indicator Direction
Historical value	Satisfaction with the Preservation of Industrial Architecture	-	16 questions for the merchant survey, 20 questions for the consumer survey	Positive
	Industrial Equipment Retention Satisfaction	-	9 questions in the merchant survey	Positive
	Overall Satisfaction with the Preservation of Industrial Heritage	-	7 questions in the merchant survey, 8 questions in the consumer survey	Positive
	Historical Recognition of Industrial Heritage	%	5 questions in the merchant survey, 17 questions in the consumer survey	Positive
The Value of Technology	Demand for Digital and Intelligent Experiences	-	11 questions in the consumer survey	Positive
	Utilization of Digital and Intelligent Technologies	-	10 questions in the merchant survey	Positive
	Intensity of investment in digital and intelligent factors	%	Internal R&D Expenditures / Chongqing's GDP	Positive
	R&D staff	per person	R&D staff	Positive
Social Value	Economic Contribution Rate of Factory No. 2	%	Annual revenue of businesses / GDP of Yuzhong District	Positive
	Per-capita consumption multiplier for Plant No. 2	%	Average daily consumer spending / Per capita GDP in Yuzhong District	Positive
	Contribution of the regional cultural and tourism economy	%	Value Added from Tourism / GDP of Yuzhong District	Positive
	Population density	people per square meter	Population of Lianglukou Subdistrict / Area of E'ling No. 2 Factory	Positive
Artistic value	Perception of Industrial Architecture	-	6 questions in the consumer survey	Positive
	Integration of Industrial Elements into Cultural and Creative Industries	-	17 questions in the merchant survey, 22 questions in the consumer survey	Positive
	Event Participation Rate	-	14 questions in the merchant survey, 18 questions in the consumer survey	Positive
	Overall Satisfaction with the Utilization of Industrial Heritage	-	15 questions in the merchant survey, 19 questions in the consumer survey	Positive

Based on the aforementioned indicator system and in accordance with the analytical requirements of the random forest model, this study further identified five core evaluation indicators: overall satisfaction with the preservation of industrial heritage (X1), demand for digital and intelligent experiences (X2), intensity of investment in digital and intelligent elements (X3), contribution to the regional cultural and tourism economy (X4), and overall satisfaction with the utilization of industrial heritage (X5). The definitions of each indicator are shown in Table 2 :

Table 2 Explanation of Indicator Names

Indicators	Indicator Name	Unit
X1	Overall Satisfaction with the Preservation of Industrial Heritage	-
X2	Demand for Digital and Intelligent Experiences	-
X3	Intensity of investment in digital and intelligent factors	%
X4	Contribution of the regional cultural and tourism economy	%
X5	Overall Satisfaction with the Utilization of Industrial Heritage	-

2.3 Data Source

2.3.1 Sampling Design

This study employs a method combining multistage PPS sampling with stratified sampling to determine the survey sample. The merchant survey employed multistage PPS sampling: In the first stage, all seven functional zones of Factory No. 2 were included in the survey scope; in the second stage, sampling areas were selected within each functional zone based on the number of merchants; in the third stage, final survey locations were selected within the sampling areas based on merchant type. A total of 26 merchant locations were sampled, covering diverse business formats such as cultural and creative retail, dining and leisure, and art exhibitions, yielding 57 valid samples. The consumer survey employed a combined method of multistage stratified sampling and PPS sampling: First, the required sample size was determined using the Cochran formula. Considering the park's maximum daily visitor capacity of $N=5,000$, a design effect of $deff=1.2$, and a preliminary survey response rate of 88.5%, the planned distribution of 500 questionnaires was established; Subsequently, PPS sampling was used to select 26 survey locations across the seven functional zones, where on-site interviews were conducted with visiting consumers. A total of 449 valid questionnaires were collected, resulting in a valid response rate of 89.8%.

2.3.2 Reliability and Validity Analysis

(1) Merchant

Table 3 Reliability and Validity Tests for the Official Survey of Merchants

Title	Cronbach's alpha	Number of items	Reliability Assessment	KMO and Bartlett's Test	
Q7	0.832	5	Better	KMO value	0.908
Q9	0.849	4	Better	Approximate chi-square	1079.684
Q15	0.902	5	Great	Bartlett's Test of Sphericity	Degrees of freedom
Q16	0.868	7	Better		
Overall Scale	0.917	21	Great	P-value	0.001

Table 3 shows that the Cronbach's alpha coefficients for each dimension range from 0.832 to 0.902, and the Cronbach's alpha coefficient for the total scale is 0.917; all are greater than 0.8. The KMO value is 0.908, and the p-value for Bartlett's sphericity test is <0.001 , indicating that the questionnaire has good reliability and validity.

Consumers

Table 4 Reliability and Validity Testing of Consumer Surveys

Title	Cronbach's alpha	Number of items	Reliability Assessment	KMO and Bartlett's Test	
Q7	0.858	7	Better	KMO value	0.964
Q8	0.823	5	Better	Approximate chi-square	6547.691
Q19	0.815	5	Better	Bartlett's Test of Sphericity	Degrees of freedom
Q20	0.863	7	Better		
Overall Scale	0.958	24	Great	P-value	0.001

As shown in Table 4, the Cronbach’s alpha coefficients for each dimension ranged from 0.815 to 0.863, and the Cronbach’s alpha coefficient for the total scale was 0.958; all were greater than 0.8. The KMO value was 0.964, and the p-value for Bartlett’s sphericity test was less than 0.001, indicating that the questionnaire has good reliability and validity.

3. Empirical Analysis

3.1 Analysis of Current Characteristics and Group Preferences

To comprehensively characterize the current status and preferences regarding the revitalization of the industrial heritage at Chongqing’s E’ling No. 2 Factory, this section employs a combination of four methods—descriptive statistics, K-means clustering, cross-tabulation, and multidimensional preference analysis—to conduct a systematic analysis from both the perspectives of businesses and consumers.

3.1.1 Analysis of Merchant and Consumer Characteristics Based on Descriptive Statistics

(1) Analysis of Merchant Characteristics

Figure 1 Pie Chart Showing the Geographic Distribution of Businesses

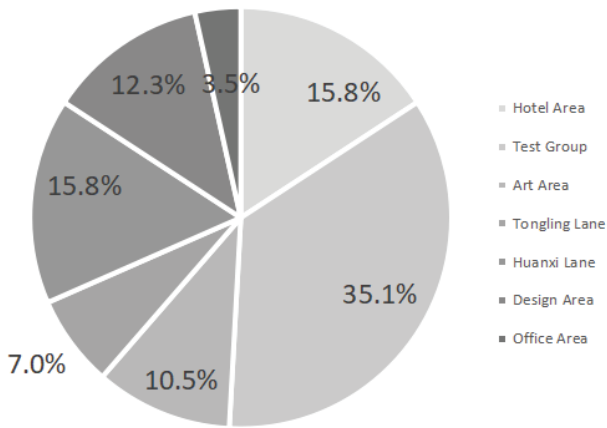


Figure 2 Bar Chart Showing the Distribution of Business Years in Operation

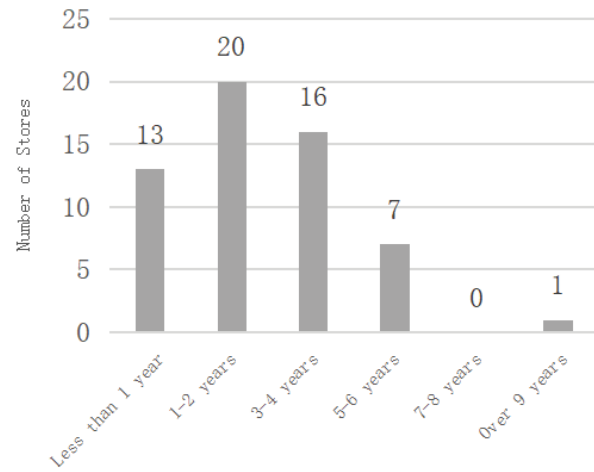
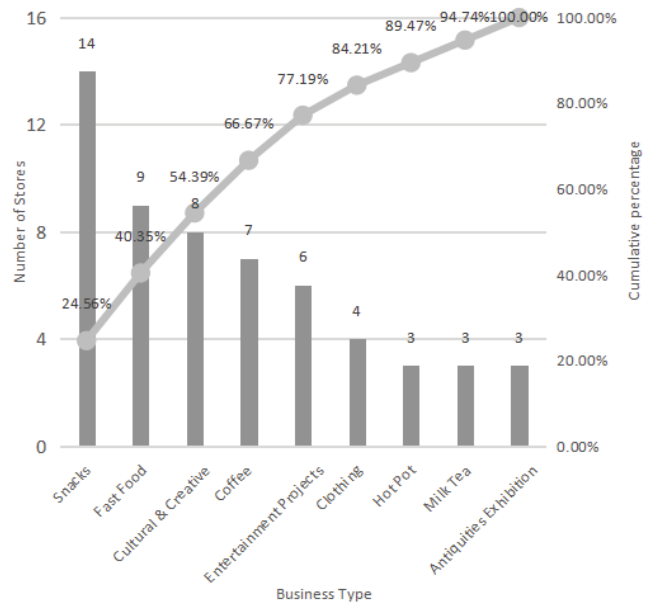


Figure 3 Bar Chart of Merchants' Average Daily Revenue



Figure 4 Pareto Chart of Business Types by Number



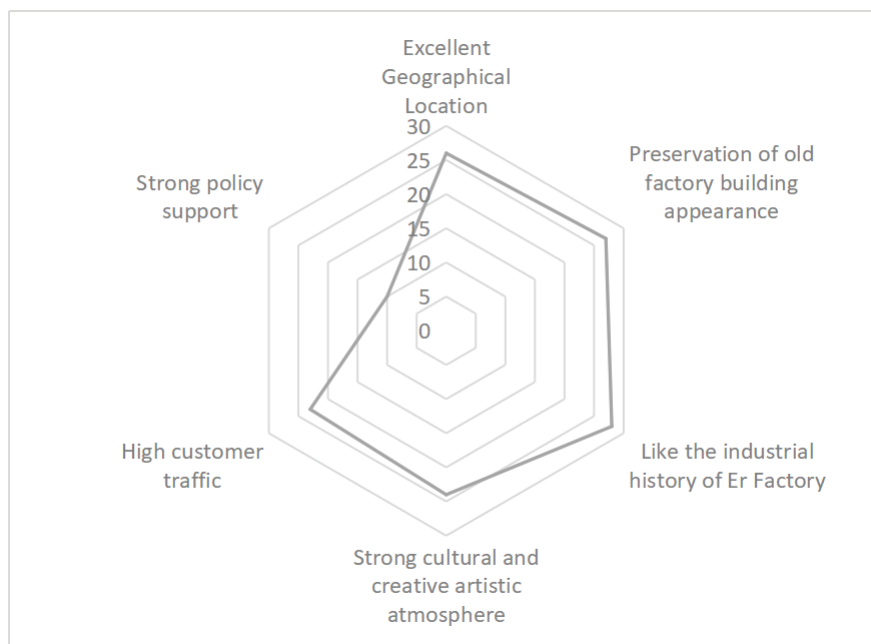
As shown in Figure 1, the Test Area accounts for the largest share at 35.1%; the Hotel Area and Huanxi Alley follow, at 15.8% and 12.3% respectively; the Art Area accounts for 10.5%; Tongling Alley accounts for 7%; and the Design Area and Office Area have the lowest shares, both at 3.5%.

As shown in Figure 2, the largest group consists of 10 businesses that have been in operation for 3–6 years, followed by 20 businesses that have been in operation for 1–2 years. Overall, the distribution is dominated by businesses that have been in operation for 3–6 years.

As shown in Figure 3, in E'ling Second Factory, 35 stores—the majority—have daily revenues of less than 4,000 yuan, with 19 of those earning less than 2,000 yuan. Only seven stores generate revenues exceeding 8,000 yuan, and just two exceed 10,000 yuan; none earn more than 12,000 yuan.

As shown in Figure 4, snack shops are the most numerous, with 14 establishments accounting for 24.56% of the total; fast-food restaurants and cultural and creative shops follow, with 9 and 8 establishments, respectively. There are 7 coffee shops, 6 entertainment venues, and 4 clothing stores. Hot pot, bubble tea, and antique exhibition shops were the least common, with 3 of each. The cumulative share curve shows that snack bars, fast-food restaurants, and cultural and creative shops collectively accounted for 54.39%, while the top six business formats together accounted for over 89%.

Figure 5 Pie Chart of Reasons for Merchants to Join



As shown in Figure 5, the key driving factors are geographical location, industrial heritage, cultural and artistic atmosphere, and visitor traffic, while the impact of policy support is relatively weak.

(2) Consumer Profile Analysis

Figure 6 Pie Chart of Consumer Gender Distribution

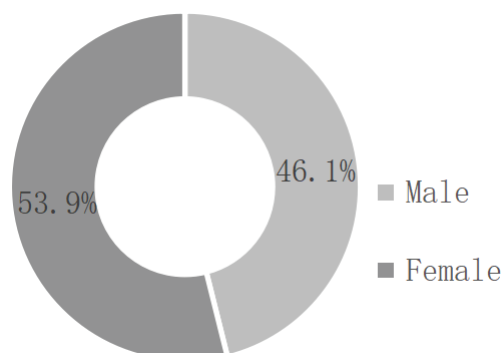
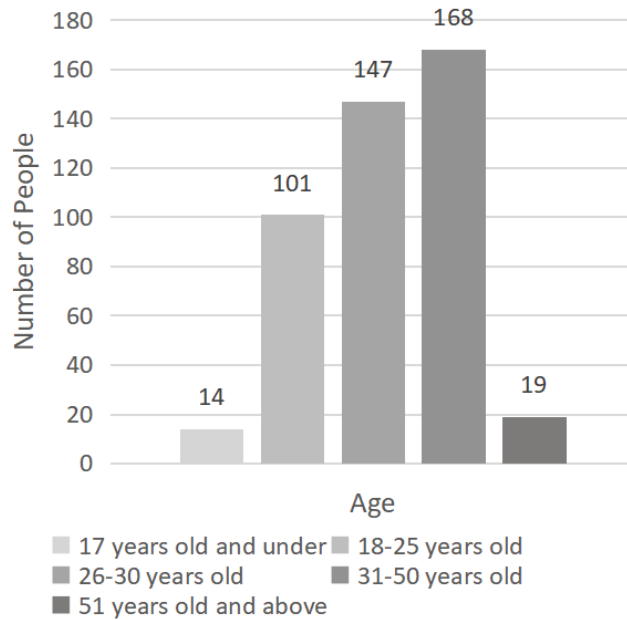


Figure 7 Bar Chart of Consumer Age Distribution



As shown in Figure 6, men account for 53.9% and women for 46.1%, indicating a relatively balanced gender distribution. As shown in Figure 7, Factory No. 2’s core consumer base consists of young and middle-aged adults aged 26–50, with relatively few minors and older adults. This suggests that young people aged 18–25 are a significant source of foot traffic.

Figure 8 Pie Chart of Consumers' Occupational Distribution

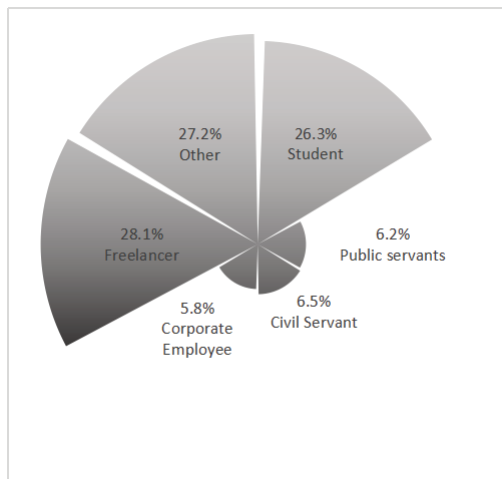
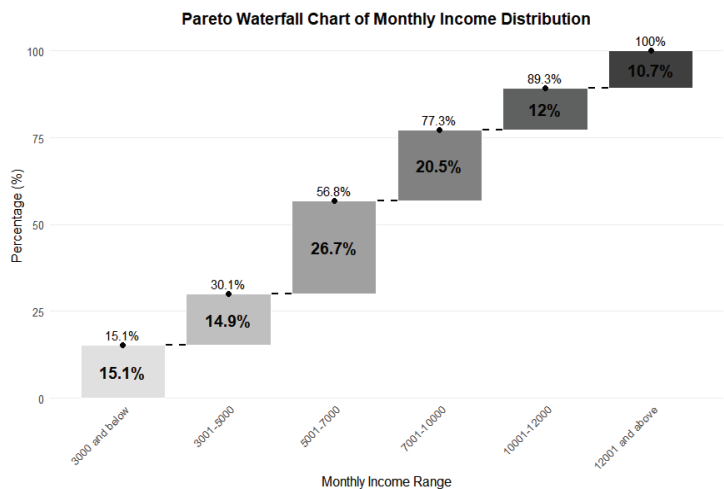


Figure 9 Waterfall Chart of Consumer Monthly Income Distribution

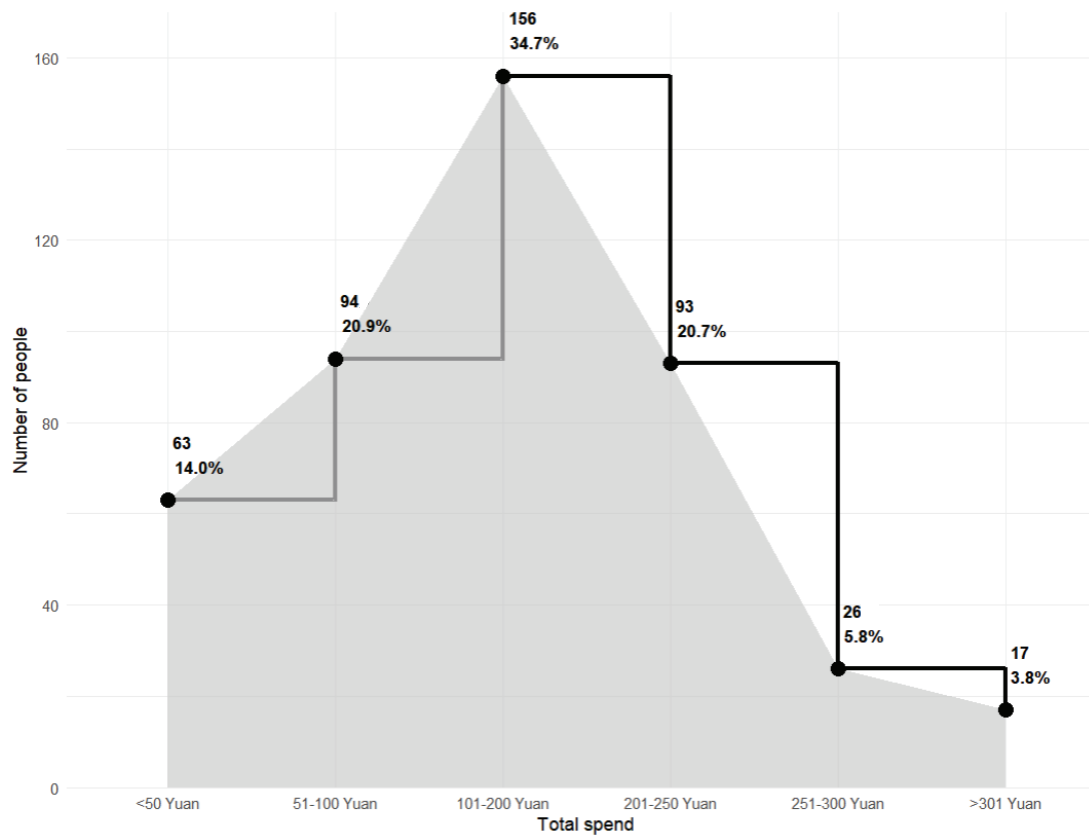


As shown in Figure 8, the core consumer base at Plant No. 2 consists of freelancers (28.1%), students (26.3%), and other occupational groups (27.2%), while civil servants, public sector employees, and corporate staff account for a smaller proportion.

As shown in Figure 9, the core consumer base at Plant No. 2 consists of middle-income earners with monthly incomes of 5,001–10,000 yuan (accounting for 47.2% of the total), while those earning less than 3,000 yuan and those earning 3,001–5,000 yuan account for 30%, and high-income earners account for approximately 22.7%.

As shown in Figure 10, single-purchase spending at Store No. 2 is primarily concentrated in the low-to-mid price range of 51–250 yuan (accounting for 76.3% of total spending), with the 101–200 yuan range being the core segment (34.7%); the proportion of high-spending customers is relatively low.

Figure 10 Chart of Consumer Spending by Amount



3.1.2 K-Means Clustering-Based Profiles of Merchants and Consumers

(1) Merchant Profile

For merchants, six variables were selected: years in business, average daily revenue, use of industrial elements, integration methods, participation in activities, and overall satisfaction. Higher values indicate a greater degree of the respective characteristic. With the number of clusters in the K-Means clustering analysis set to 4, the results obtained using SPSS were found to be the most reasonable. Through iterative calculations, the number of cases in each cluster was determined, as shown in Table 5, and the final cluster centers are presented in Table 6:

Table 5 Number of Stores in Each Cluster

Clustering	1	23.000
	2	2.000
	3	1.000
	4	31.000
Valid		57.000
Missing		0.000

Table 6 Final Store Cluster Centers

Name	Clustering			
	1	2	3	4
Daily Store Revenue	0.17481	0.24879	0.81605	-0.17207
Years in Business	-0.22045	0.58504	1.51136	0.07706
Use of Industrial Elements	0.68039	2.33071	2.33071	-.73036
Integration Methods	0.70911	2.57519	-0.85840	-.66456
Event Participation	0.49070	2.96189	2.54087	-.63712
Overall Satisfaction	0.13971	1.28661	-3.96095	-.05889

To determine whether there are significant differences among the categories across the various variables, an analysis of variance (ANOVA) was conducted (see Table 7):

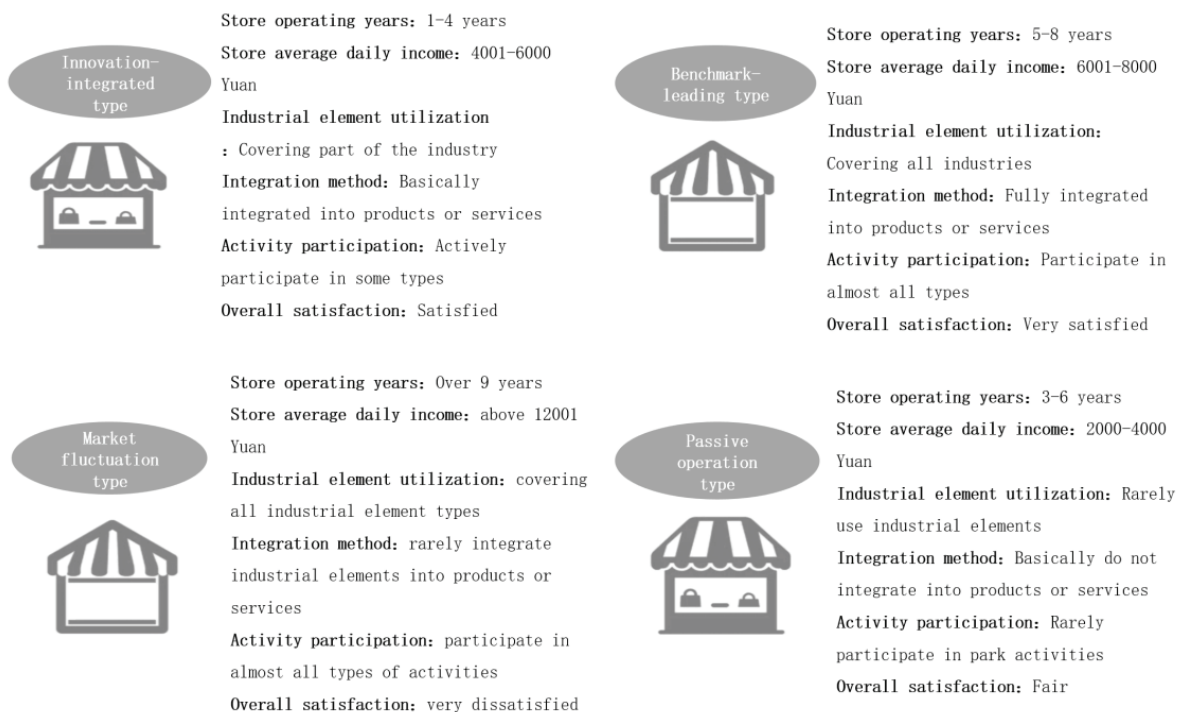
Tbale 7 Results of the ANOVA Analysis for Store Clustering

Name	Clustering		Error		F	Significance
	Mean Square	Degrees of Freedom	Mean Square	Degrees of Freedom		
Daily Store Revenue	0.803	3	1.011	53	0.795	0.502
Years in Business	1.424	3	0.976	53	1.459	0.236
Use of Industrial Elements	14.493	3	0.236	53	61.356	0.000
Integration Methods	13.085	3	0.316	53	41.420	0.000
Event Participation	14.041	3	0.262	53	53.629	0.000
Overall Satisfaction	6.519	3	0.688	53	9.480	0.000

The results in Table 7 show that there were highly significant differences in the amount of industrial elements utilized ($F=61.356$, $p<0.001$), the methods of integration ($F=41.420$, $p<0.001$), the level of activity participation ($F=53.629$, $p<0.001$), and overall satisfaction ($F=9.480$, $p<0.001$), while no significant differences were found for daily income ($p=0.502$) and years in business ($p=0.236$). This indicates that the classification of merchants is influenced by the depth and manner of their participation in industrial heritage revitalization.

Based on store operational characteristics, engagement levels, and satisfaction ratings, we have categorized stores into the following four types. The store profiles are shown in Figure 11:

Figure 11 Store Profile



(2) Consumer Profile

Consumers were classified based on eight variables: age, monthly income, spending amount, cultural interests, technological needs, willingness to participate in activities, perceived elements, and overall satisfaction. With the number of clusters in the K-Means clustering analysis set to four, the results obtained using SPSS were found to be the most reasonable. Through iterative calculations, the number of cases in each cluster was determined, as shown in Table 8, and the final cluster centers are presented in Table 9:

Table 8 Number of Consumers in Each Cluster

Clustering	1	55.000
	2	95.000
	3	221.000
	4	78.000
Valid		449.000
Missing		0.000

Table 9 Final Consumer Cluster Centers

Name	Clustering			
	1	2	3	4
Age	0.53874	-0.82922	0.32634	-0.29456
Monthly Income	0.45137	-0.92005	0.51092	-0.64530
Spending Amount	0.52475	-0.78547	0.47896	-0.77041
Cultural Interests	1.65711	-0.67905	-0.39320	0.77263
Technology Needs	1.54321	-0.59126	-0.37866	0.70482
Willingness to Participate in Activities	1.79285	-0.64025	-0.37574	0.58020
Perceived Elements	1.67622	-0.67191	-0.39744	0.76249
Overall Satisfaction	0.61676	-0.72531	0.16590	-0.02155

To determine whether there are significant differences among the categories across the various variables, an analysis of variance (ANOVA) was conducted (see Table 10).

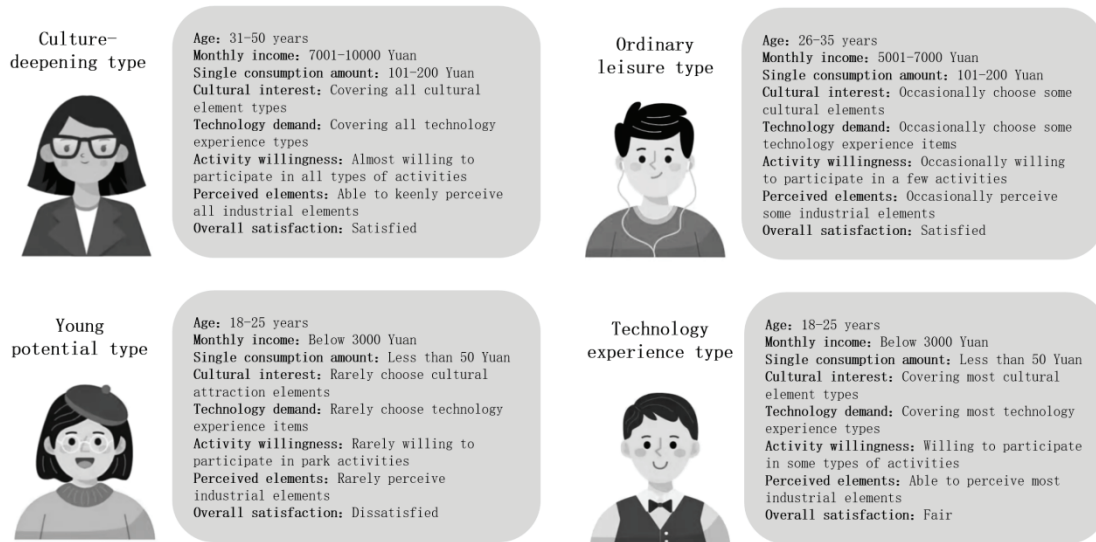
Table 10 Results of the ANOVA Analysis of Consumer Clusters

Name	Clustering		Error		F	Significance
	Mean Square	Degrees of Freedom	Mean Square	Degrees of Freedom		
Age	37.196	3	0.756	445	49.203	0.000
Monthly Income	60.597	3	0.598	445	101.295	0.000
Spending Amount	56.917	3	0.623	445	91.354	0.000
Cultural Interests	91.855	3	0.387	445	237.051	0.000
Technology Needs	78.209	3	0.479	445	163.111	0.000
Willingness to Participate in Activities	91.062	3	0.393	445	231.806	0.000
Perceived Elements	92.560	3	0.383	445	241.837	0.000
Overall Satisfaction	25.672	3	0.834	445	30.794	0.000

As shown in Table 10, significant differences were found across all eight variables among the four consumer groups ($p < 0.001$). Among these, the F-values for perceived elements, cultural interest, and willingness to participate were the highest, making them the core variables for distinguishing between consumer groups; technological needs, monthly income, and spending amount followed; and age and overall satisfaction also showed significant differences. Consumer classification is primarily influenced by cultural interest, perceptual sensitivity, and willingness to participate in activities.

Based on consumers' basic characteristics, consumption behavior, interests and preferences, perceived value, and satisfaction ratings, we have categorized consumers into the following four groups. The consumer profiles are shown in Figure 12:

Figure 12 Consumer Profile



3.1.3 Analysis of the Relationship Between Merchants and Consumers Based on Cross-Tabulation

(1) Cross-Analysis of Merchants

Using the store’s location as the column variable, conduct a cross-tabulation analysis of the primary reasons merchants have chosen to set up shop at E'ling No. 2 Factory (with the row variables being: prime location, well-preserved industrial architecture, appreciation for E'ling No. 2 Factory’s industrial history, vibrant cultural and creative atmosphere, high foot traffic, and strong policy support, denoted as a–f, respectively).

Table 11 Cross-tabulation of Region and Reasons for Moving into Factory No. 2

Region		a	b	c	d	e	f	Total	
Region	Hotel District	Count	4	8	4	4	2	1	23
		Percentage	17.4%	34.8%	17.4%	17.4%	8.7%	4.3%	100.0%
	Trial Collection District	Count	10	5	9	7	11	0	42
		Percentage	23.8%	11.9%	21.4%	16.7%	26.2%	0.0%	100.0%
	Art District	Count	2	2	2	2	2	0	10
		Percentage	20.0%	20.0%	20.0%	20.0%	20.0%	0.0%	100.0%
	Spirit Lane	Count	3	1	1	3	1	1	10
		Percentage	30.0%	10.0%	10.0%	30.0%	10.0%	10.0%	100.0%
	Joy Lane	Count	3	6	4	5	4	1	23
		Percentage	13.0%	26.1%	17.4%	21.7%	17.4%	4.3%	100.0%
	Design District	Count	5	4	4	5	2	1	21
		Percentage	23.8%	19.0%	19.0%	23.8%	9.5%	4.8%	100.0%
	Office District	Count	0	1	0	1	1	2	5
		Percentage	0.0%	20.0%	0.0%	20.0%	20.0%	40.0%	100.0%
	Total	Count	27	27	24	27	23	6	134
		Percentage	20.1%	20.1%	17.9%	20.1%	17.2%	4.5%	100.0%

As shown in Table 11, 20.1% of businesses chose to set up shop at Erchang due to its prime location, the charm of the old factory buildings, and the creative and cultural atmosphere. Policy support was the least common reason (4.5%). By zone, the Hotel Zone and Huanxi Alley are primarily driven by the industrial heritage; the Market Zone and Design Zone prioritize location and foot traffic; Tongling Alley favors location and the creative atmosphere; the Office Zone cites policy support as

the primary factor; and the Art Zone shows a balanced distribution of factors, with no policy-driven motivation..

A cross-tabulation analysis was conducted using the type of industrial heritage utilization as the row variable and overall satisfaction with the revitalization of Factory No. 2's industrial heritage (A = Very Dissatisfied, B = Dissatisfied, C = Neutral, D = Satisfied, E = Very Satisfied) as the column variable.

Table 12 Cross-tabulation of industrial element utilization and overall satisfaction with utilization

Dimension			A	B	C	D	E	Total
Industrial Element Utilization	Machinery and Equipment	Count	1	0	7	9	7	24
		Percentage	4.17%	0.00%	29.17%	37.50%	29.17%	100.00%
	Building Structures	Count	0	1	5	12	4	22
		Percentage	0.00%	4.55%	22.73%	54.55%	18.18%	100.00%
	Historical Artifacts	Count	0	1	6	4	14	25
		Percentage	0.00%	4.00%	24.00%	16.00%	56.00%	100.00%
	Historical Slogans	Count	0	0	11	8	5	24
		Percentage	0.00%	0.00%	45.83%	33.33%	20.83%	100.00%
	Spatial Layout	Count	0	2	9	4	2	17
		Percentage	0.00%	11.76%	52.94%	23.53%	11.76%	100.00%
	Total	Count	1	4	38	37	32	112
		Percentage	0.89%	3.57%	33.93%	33.04%	28.57%	100.00%

As shown in Table 12, looking at the overall distribution, merchants' satisfaction with the overall revitalization and utilization of the No. 2 Factory industrial heritage was primarily "neutral" (33.93%) and "satisfied" (33.04%), followed by "very satisfied" (28.57%), while "dissatisfied" and "very dissatisfied"

(3) Consumer Cross-Analysis

Conduct a cross-tabulation with age as the row variable (17 and under, 18–25, 26–30, 31–50, 51 and over) and average transaction amount as the column variable.

Table 13 Cross-tabulation of spending amounts by age

Dimension			17 and under	18-25	26-30	31-50	51 and over	Total
Total amount spent	Less than 50 yuan	Count	8	27	6	19	3	63
		Percentage	12.7%	42.9%	9.5%	30.2%	4.8%	100.0%
	51–100 yuan	Count	3	34	26	29	2	94
		Percentage	3.2%	36.2%	27.7%	30.9%	2.1%	100.0%
	101–200 yuan	Count	1	24	61	60	10	156
	101–200 yuan	Percentage	0.6%	15.4%	39.1%	38.5%	6.4%	100.0%
	201–250 yuan	Count	2	12	37	39	3	93
		Percentage	2.2%	12.9%	39.8%	41.9%	3.2%	100.0%
	251–300 yuan	Count	0	2	10	13	1	26
		Percentage	0.0%	7.7%	38.5%	50.0%	3.8%	100.0%
	301 yuan and above	Count	0	2	7	8	0	17
		Percentage	0.0%	11.8%	41.2%	47.1%	0.0%	100.0%
	Total	Count	14	101	147	168	19	449

As shown in Table 13, there are significant differences in average transaction amounts and consumer age distribution. In the low-spending bracket (under 50 yuan), the 18–25 age group accounts for the highest proportion at 42.9%. In the mid-to-high spending bracket (101 yuan and above), both the 26–30 and 31–50 age groups account for nearly 40% of the total, making them the core consumer demographic.

A cross-tabulation analysis was conducted using occupation as the row variable and the attractions of Factory No. 2 (including its industrial history, unique architectural style, banknote-themed exhibition, occasional art exhibitions and market events, insights into the daily lives of former employees, and its retro industrial aesthetic—which is popular for photo opportunities—coded as A1–A6) as the column variables.

Table 14 Cross-reference table of professions and Factory 2 attractions

Dimension		A1	A2	A3	A4	A5	A6	Total		
Occupation	Student	Count	38	44	31	65	21	11	210	
		Percentage	18.1%	21.0%	14.8%	31.0%	10.0%	5.2%	100.0%	
	Civil servant	Count	32	57	33	84	22	7	235	
		Percentage	13.6%	24.3%	14.0%	35.7%	9.4%	3.0%	100.0%	
	Freelancer	Count	25	44	49	86	24	8	236	
		Percentage	10.6%	18.6%	20.8%	36.4%	10.2%	3.4%	100.0%	
	Corporate employee	Count	27	41	41	93	21	4	227	
		Percentage	11.9%	18.1%	18.1%	41.0%	9.3%	1.8%	100.0%	
	Public sector employee	Count	31	32	35	55	17	8	178	
		Percentage	17.4%	18.0%	19.7%	30.9%	9.6%	4.5%	100.0%	
	Other	Count	18	19	13	23	9	6	88	
		Percentage	20.5%	21.6%	14.8%	26.1%	10.2%	6.8%	100.0%	
	Total		Count	171	237	202	406	114	44	1174

As shown in Table 14, art markets and exhibitions are the top choice among consumers across all professions, with corporate employees showing the strongest preference. Architectural style and ambiance rank second, while other professions are more interested in industrial history and science education; preferences among employees of public institutions are relatively balanced.

(1) Cross-Analysis of Merchants and Consumers

A cross-tabulation analysis of merchant and consumer satisfaction with the preservation of the architectural style of the seven building types at E'ling No. 2 Factory is presented in Table 15

Table 15 Cross-tabulation of Satisfaction with the Preservation of Architectural Features Among Merchants and Consumers

Dimension		1	2	3	4	5	6		
Steel roof trusses	Main Body	Merchants	Count	2	0	18	25	12	57
			Percentage	3.50%	0.00%	31.60%	43.90%	21.10%	100.00%
	Consumers	Count	3	13	78	188	167	449	
		Percentage	0.70%	2.90%	17.40%	41.90%	37.20%	100.00%	
	Total		Count	5	13	96	213	179	506
			Percentage	1.00%	2.60%	19.00%	42.10%	35.40%	100.00%

Dimension			1	2	3	4	5	6	
Red brick walls	Main Body	Merchants	Count	3	1	14	27	12	57
			Percentage	5.30%	1.80%	24.60%	47.40%	21.10%	100.00%
		Consumers	Count	7	9	64	203	166	449
			Percentage	1.60%	2.00%	14.30%	45.20%	37.00%	100.00%
	Total	Count	10	10	78	230	178	506	
		Percentage	2.00%	2.00%	15.40%	45.50%	35.20%	100.00%	
Concrete beams and columns	Main Body	Merchants	Count	2	1	20	21	13	57
			Percentage	3.50%	1.80%	35.10%	36.80%	22.80%	100.00%
		Consumers	Count	4	5	58	223	159	449
			Percentage	0.90%	1.10%	12.90%	49.70%	35.40%	100.00%
	Total	Count	6	6	78	244	172	506	
		Percentage	1.20%	1.20%	15.40%	48.20%	34.00%	100.00%	
Roof terrace	Main Body	Merchants	Count	4	0	13	27	13	57
			Percentage	7.00%	0.00%	22.80%	47.40%	22.80%	100.00%
		Consumers	Count	5	9	80	193	162	449
			Percentage	1.10%	2.00%	17.80%	43.00%	36.10%	100.00%
	Total	Count	9	9	93	220	175	506	
		Percentage	1.80%	1.80%	18.40%	43.50%	34.60%	100.00%	
Iron gate	Main Body	Merchants	Count	2	0	20	20	15	57
			Percentage	3.50%	0.00%	35.10%	35.10%	26.30%	100.00%
		Consumers	Count	4	13	97	201	134	449
			Percentage	0.90%	2.90%	21.60%	44.80%	29.80%	100.00%
	Total	Count	6	13	117	221	149	506	
		Percentage	1.20%	2.60%	23.10%	43.70%	29.40%	100.00%	
Roof	Main Body	Merchants	Count	2	1	17	31	6	57
			Percentage	3.50%	1.80%	29.80%	54.40%	10.50%	100.00%
		Consumers	Count	2	18	102	197	130	449
			Percentage	0.40%	4.00%	22.70%	43.90%	29.00%	100.00%
	Total	Count	4	19	119	228	136	506	
		Percentage	0.80%	3.80%	23.50%	45.10%	26.90%	100.00%	

Dimension			1	2	3	4	5	6	
Chimney	Main Body	Merchants	Count	2	1	13	29	12	57
			Percentage	3.50%	1.80%	22.80%	50.90%	21.10%	100.00%
		Consumers	Count	6	8	76	203	156	449
			Percentage	1.30%	1.80%	16.90%	45.20%	34.70%	100.00%
	Total		Count	8	9	89	232	168	506
			Percentage	1.60%	1.80%	17.60%	45.80%	33.20%	100.00%
Total	Main Body	Merchants	Count	17	4	115	180	83	399
			Percentage	4.30%	1.00%	28.80%	45.10%	20.80%	100.00%
		Consumers	Count	31	75	555	1408	1074	3143
			Percentage	1.00%	2.40%	17.70%	44.80%	34.20%	100.00%
	Total		Count	48	79	670	1588	1157	3542
			Percentage	1.40%	2.20%	18.90%	44.80%	32.70%	100.00%

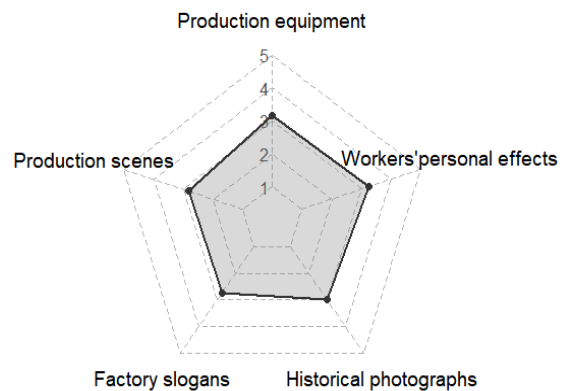
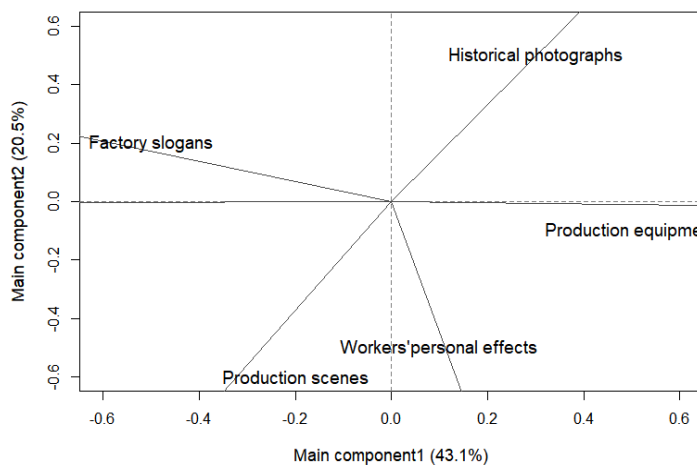
As shown in Table 15, satisfaction levels were high in both groups, with the core rating being 4 (satisfied). Merchants tended to be more conservative in their ratings, with a higher proportion (28.8%) giving a 3 compared to consumers (17.7%); conversely, consumers were more generous, with a higher proportion (34.2%) giving a 5 compared to merchants (20.8%).

3.1.4 Analysis of Consumer Behavior Characteristics Based on Multidimensional Preference Analysis

To address the nonlinear relationships between attributes and preferences, as well as the issue of dimensional overlap in high-dimensional data, this study collected data using a ranking question for Q9 in the consumer questionnaire and employed principal component plots and radar charts to conduct a multidimensional preference analysis.

Figure 13 Dimension Map of Element Preferences at Plant No. 2

Figure 14 Radar Chart of Element Preference Scores for the Old Factory Building at Plant No. 2



As shown in Figure 13, production equipment and historical images are located in the positive region of Principal Component 1, workers' items are located in the negative region of Principal Component 2, production scenes are located in the negative regions of both principal components, and factory slogans are located near the center. Principal Component 1 explains 43.1% of the variance, while Principal Component 2 explains 20.5%. The distribution of production equipment, historical images, and workers' items in the principal component space is relatively concentrated, while the distribution of production scenes and factory slogans is relatively dispersed.

As shown in Figure 14, the preference scores for the five categories range from 2.8 to 3.8. Workers' items received the highest

score (approximately 3.8), followed by production equipment (approximately 3.5), historical photographs (approximately 3.2), and production scenes (approximately 2.9), while slogans on the factory premises received the lowest score (approximately 2.8).

3.2 Identification and Visualization of Influencing Factors

To identify the key drivers of the revitalization of the E'ling No. 2 Factory Industrial Heritage Site in E'rling, Chongqing, and to conduct an interpretable analysis, this section employs a random forest model to identify influencing factors and introduces the SHAP method to visually interpret the model results.

3.2.1 Analysis of Factors Influencing the Revitalization of the No. 2 Factory Industrial Heritage Based on a Random Forest Model

Using the indicator system developed earlier and the five core indicators selected, we will employ a random forest model to conduct an empirical analysis of the mechanisms influencing the revitalization outcomes of the E'er Factory industrial heritage site in E'ling, Chongqing. The model exhibits excellent fit: R^2 for the training set is 0.9152, and R^2 for the test set is 0.9076. These values are highly similar and both exceed 0.9, indicating no significant overfitting or underfitting issues. The model's stability and predictive reliability have been fully validated.

Figure 15 Correlation matrix of variables in the Random Forest model

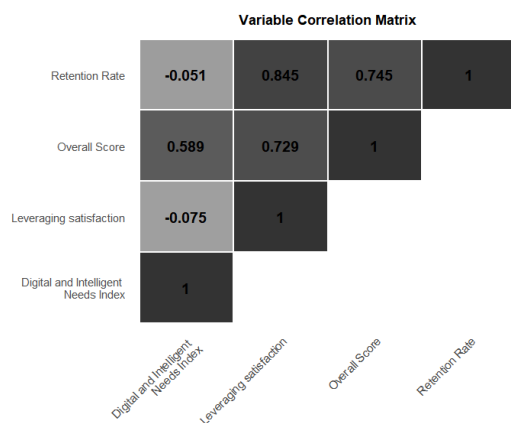
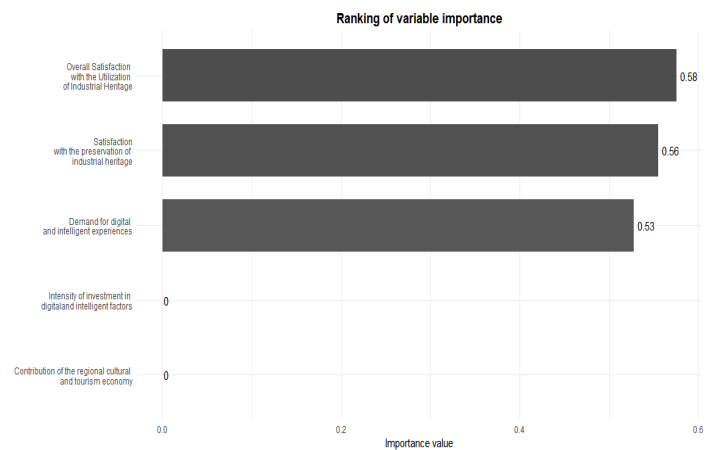


Figure 16 Random Forest Importance Ranking Chart



As shown in Figure 15, there is a strong positive correlation between usage satisfaction, retention satisfaction, and the overall score (with correlation coefficients of 0.845, 0.745, and 0.729, respectively), indicating a highly synergistic positive relationship among the three. Digital and intelligent needs show a moderate positive correlation with the overall score (0.589) but exhibit virtually no linear relationship with usage satisfaction or retention satisfaction.

As shown in Figure 16, satisfaction with the overall utilization of industrial heritage, satisfaction with the overall preservation of industrial heritage, and the demand for digital and intelligent experiences are the core drivers influencing the effectiveness of industrial heritage revitalization, with importance coefficients of 0.58, 0.56, and 0.53, respectively. Since the intensity of investment in digital and intelligent elements and the contribution rate to the regional cultural and tourism economy are macroeconomic indicators, they were not included in the random forest model. As important external conditions for revitalization, these two factors can amplify their positive impact on user experience by increasing investment in digital and intelligent technologies and strengthening the integration of culture and tourism.

3.2.2 SHAP-Based Model Interpretation Visualization

To further elucidate the specific mechanisms by which each variable influences the prediction of consumer types, this study employed the SHAP method to conduct an interpretive analysis of the random forest model. The SHAP score is based on cooperative game theory; it quantifies the marginal contribution of each feature to the prediction result and also indicates the direction and magnitude of this influence.

Figure 17 Summary Chart of SHAP Values for the Revitalization of Industrial Heritage

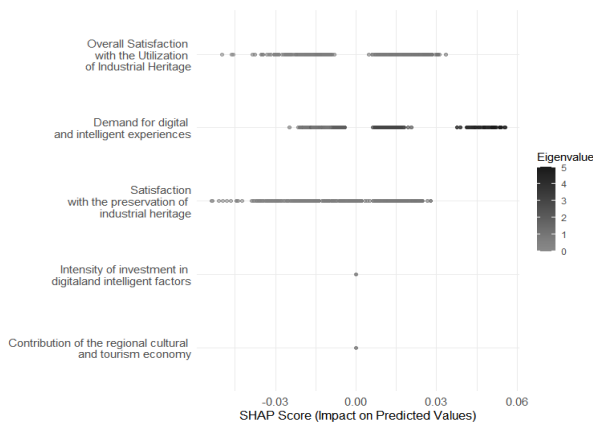


Figure 18 SHAP Dependency Plot for Overall Satisfaction with the Preservation of Industrial Heritage

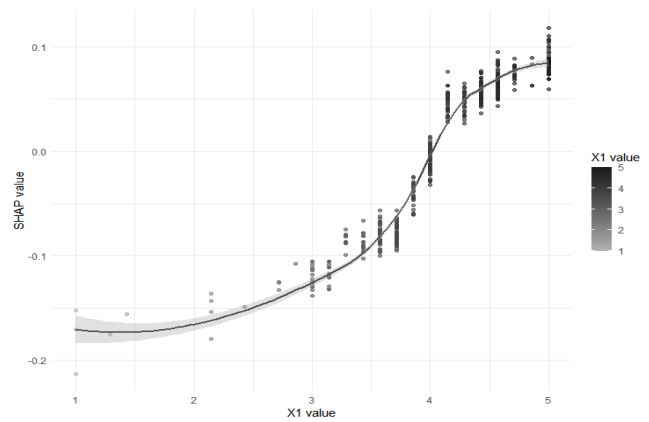


Figure 19 SHAP Dependency Diagram for Digital and Intelligent Experience Demand

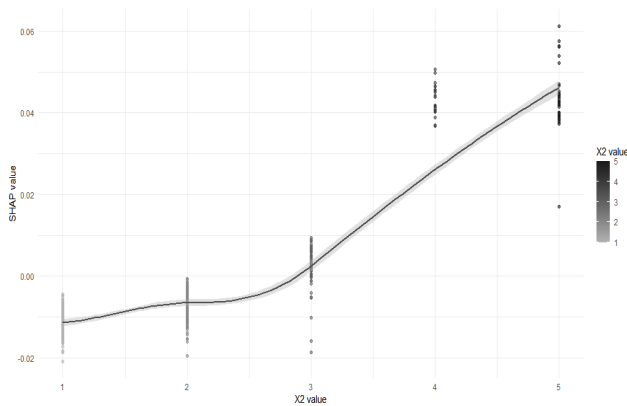
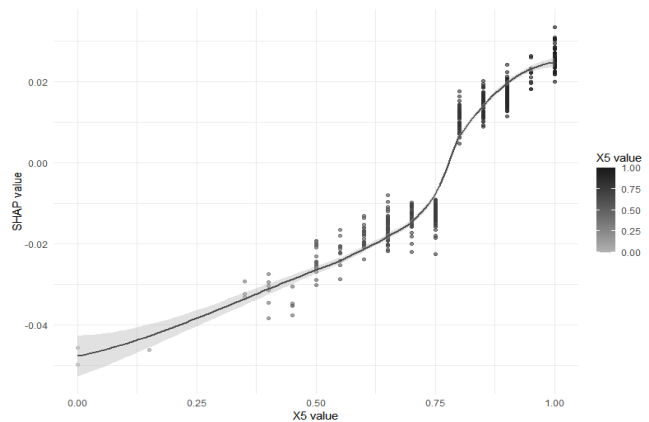


Figure 20 SHAP Dependency Map of Overall Satisfaction with the Utilization of Industrial Heritage



As shown in Figure 17, overall satisfaction with the utilization of industrial heritage, the demand for digital and intelligent experiences, and overall satisfaction with preservation exert a core influence on the revitalization effect. Meanwhile, the SHAP values for the intensity of investment in digital and intelligent elements and the contribution rate to the regional cultural and tourism economy are concentrated at 0, indicating no significant influence. This is generally consistent with the characteristics of these macro indicators, thereby validating the robustness of our model.

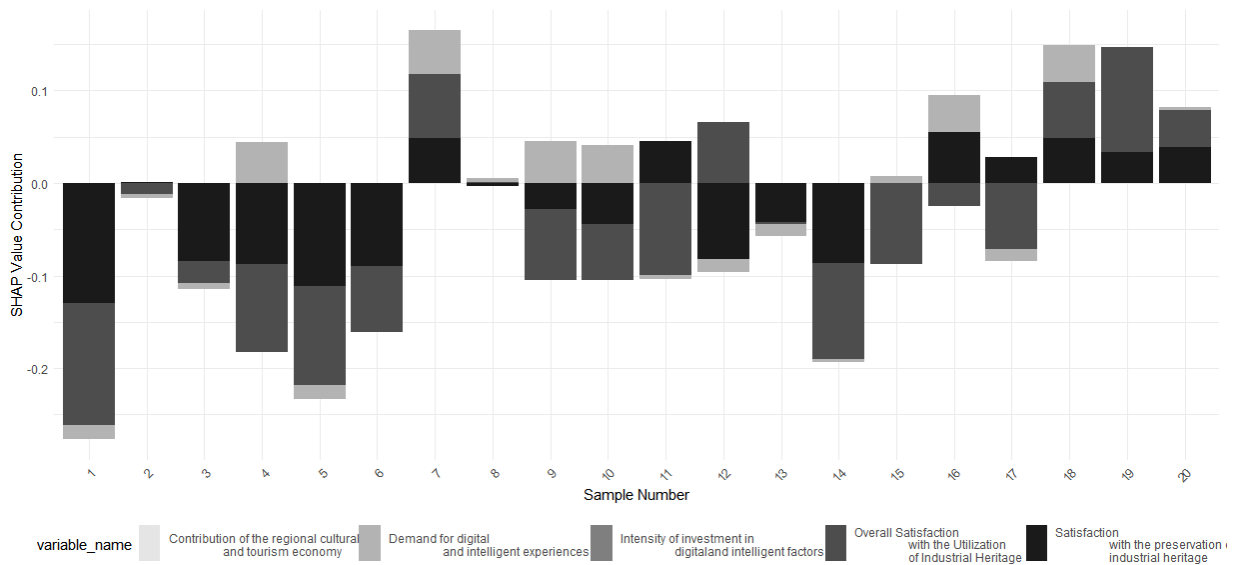
As shown in Figure 18, satisfaction with preservation moves in the same direction as the SHAP values, with the growth rate increasing significantly once the value exceeds 0.75.

As shown in Figure 19, the demand score for digital and intelligent experiences continues to rise, increasing from 1 to 5, while the SHAP value also rises steadily from approximately -0.02 to above 0.05.

As shown in Figure 20, the overall satisfaction score for the utilization of industrial heritage increased from 0 to 1, while the SHAP score decreased steadily from approximately -0.045 to approximately -0.170; the two variables exhibit a negative correlation. The higher the X5 value, the lower the SHAP score, and the greater the negative impact on the predicted value.

As shown in Figure 21, the SHAP value distributions for all variables exhibit distinct discrete characteristics. The SHAP value distributions for the three variables—overall satisfaction with the preservation of industrial heritage, overall satisfaction with its utilization, and demand for digital and intelligent experiences—have a wide range, with high values primarily concentrated in the positive range; in contrast, the SHAP value distributions for the intensity of investment in digital and intelligent elements and the contribution rate to the regional cultural and tourism economy are relatively concentrated, with most values clustered around the 0-axis.

Figure 21 SHAP Contribution Decomposition Plots for Each Sample



4. Research Findings and Recommendations

4.1 Conclusion

Through a systematic survey of merchants and consumers at the E'ling No. 2 Factory Cultural and Creative Park in E'ling No. 2 Factory, Chongqing, and by combining methods such as descriptive statistics, K-means clustering, cross-tabulation, random forest models, and SHAP interpretability analysis, this study reached the following main conclusions:

4.1.1 The Revitalization of the E'ling No. 2 Factory Industrial Heritage Site in E'ling, Chongqing, Has Yielded Significant Results.

According to survey data, overall satisfaction among both consumers and merchants is quite high. Most businesses have been in operation for between three and six years, and approximately 30% of them report daily revenues exceeding 4,000 yuan, indicating that the overall commercial vitality of the area is steadily increasing. These characteristics suggest that Chongqing's E'ling No. 2 Factory has established a preliminary foundation for the revitalization of industrial heritage, with its scale continuing to expand and certain advantages gradually emerging. This creates favorable conditions for further deepening the revitalization and utilization of the site in the future.

4.1.2 There Is a High Degree of Consensus Regarding the Value of Revitalizing the Industrial Heritage of Chongqing's E'ling No. 2 Factory, but There Are Structural Differences in How This Value Is Perceived in Practice

(1) Since both businesses and consumers agree on the need to fully tap into the historical and cultural value of these sites to create new growth opportunities for cultural consumption, government authorities and park management have consistently and proactively worked to uncover this value, thereby effectively contributing to economic and social development and improving the quality of life for the people.

(2) Since the proportion of consumers who are "very satisfied" with the preservation of the architectural character (34.2%) is higher than that of merchants (20.8%)—with merchants tending to be relatively more conservative in their evaluations—there is a discrepancy in how operators and consumers perceive the details of heritage preservation. As this cultural and creative park is still in its growth phase, there remains significant room to further explore its historical value.

4.1.3 Digital and Intelligent Applications Have Become the Driving Force behind the Revitalization of the E'Factory Industrial Heritage Site in E'ling, Chongqing

(1) The results of the Random Forest model indicate that satisfaction with the revitalization and utilization of the E'ling No. 2 Factory industrial heritage site in Chongqing (0.58) and overall satisfaction with its preservation (0.57) are the primary driving variables, while the demand for digital and intelligent experiences (0.49) serves as the innovation-driven variable.

(2) The SHAP explanatory analysis clearly demonstrates that users with higher digital and intelligent experience needs make

a significant contribution to evaluations, and this does not conflict with satisfaction regarding preservation. Therefore, digital-intelligent integration can naturally and appropriately serve as a viable path for “dynamic revitalization,” aligning closely with the overall trend of accelerating growth in new drivers and the continuous strengthening of cultural confidence.

4.1.4 Innovative, Community-Integrated Businesses and Young, Promising Consumers Have Become the Driving Force behind the Revitalization of the E'liang No. 2 Factory Industrial Heritage Site in Chongqing.

(1) Using K-Means clustering analysis on the survey data, businesses were categorized into four types: benchmark-leading, innovation-integrated, market-volatile, and passive-operating; while consumers were categorized into four types: culturally engaged, young and promising, casual leisure, and tech-experience.

(2) Significant differences were observed across these groups in three key areas: the level of engagement with different categories of industrial heritage revitalization at Chongqing E'ling No. 2, satisfaction with the revitalization efforts, and demand for digital and intelligent solutions. These findings provide a scientific basis and strategic direction for the park's operational management, facilitating the implementation of differentiated management approaches.

4.2 Recommendations

Based on the above conclusions, and in order to continue promoting the revitalization and sustainable development of the E'chang No. 2 Factory industrial heritage site in E'ling, Chongqing, this study offers the following recommendations from the perspectives of the government, businesses, consumers, and the park management.

4.2.1 At the Government Level: Strengthening Strategic Guidance and Policy Coordination

As a historic industrial site, Chongqing's E'ling No. 2 Factory embodies the city's modern industrial heritage and urban cultural legacy. It is recommended that attention be focused on the following areas:

- (1) Develop strategic plans and initiatives for its digital and intelligent transformation, covering policy guidance, industrial prosperity, business model innovation, institutional improvement, oversight and implementation, and feedback-driven optimization;
- (2) It is recommended to increase support for the digital and intelligent transformation of industrial heritage sites. This could be achieved by establishing special subsidies or introducing supporting policies to encourage the exploration and application of technologies such as VR, AR, smart guided tours, and digital collectibles;
- (3) By incorporating Factory No. 2 into integrated regional cultural and tourism itineraries, interdepartmental coordination can be improved, thereby enhancing the overall contribution of the cultural and tourism economy.

4.2.2 At the Business Level: Enhancing Differentiation and Collaboration Capabilities

Businesses should continuously elevate their perspective and awareness, fully leveraging the new framework of coordinated development in historical heritage, cultural and creative clusters, and cultural tourism consumption that has taken shape at Chongqing E'ling No. 2 Factory, and focus on the following areas:

- (1) Further enhance the distinctiveness and uniqueness of their revitalization of industrial elements. Businesses dealing with historical artifacts and machinery should continue to deepen physical displays and narrative-driven scenarios, while those focused on spatial layout and historical slogans should strengthen the integration of physical elements with cultural significance;
- (2) Moderately explore the integration of digital and intelligent technologies. Retail and cultural and creative businesses may experiment with lightweight applications such as AR interactions and digital check-ins to enrich the consumer experience;
- (3) Build a collaborative development network. Consider establishing a merchant alliance to enhance merchant loyalty and overall operational stability through joint marketing and experience sharing.

4.2.3 At the Consumer level: Designing Differentiated Experiences to Strengthen Cultural Connections

Design differentiated and personalized new consumer experiences at the Chongqing E'ling No. 2 Factory industrial heritage site tailored to different consumer groups. Specific considerations include:

- (1) For culturally engaged consumers, offer in-depth historical commentary, AR recreations of production scenes, and oral histories from former employees;
- (2) For young, high-potential consumers, enhance photo-worthy spots, themed markets, and light interactive activities to

cultivate their long-term interest;

(3) For casual leisure consumers, optimize the mix of dining, cultural and creative products, and leisure offerings to appropriately extend their visit duration;

(4) For tech-savvy consumers, prioritize the deployment of VR tours, digital collectible experiences, and real-time information queries.

4.2.4 At the Park Management Level: Establishing a Multi-Stakeholder Collaborative Revitalization Governance Mechanism

Park management can play a more proactive and central role in operations and management:

(1) Establish a multi-stakeholder collaborative revitalization governance mechanism, create a two-way feedback platform for merchants and consumers, regularly publish relevant revitalization indices, and dynamically monitor metrics such as satisfaction, digital and intelligent needs, and business performance;

(2) Strengthen the development of digital and smart infrastructure and the implementation of practical applications. Leveraging existing conditions, deploy applications such as smart visitor flow monitoring, AR real-time navigation, and VR immersive exhibition halls to advance digital and smart upgrades in key areas;

(3) Enrich themed activities and brand promotion. Plan events such as night tours, themed immersive experiences, and digital art exhibitions in conjunction with relevant occasions to increase repeat visit rates and enhance promotional impact;

(4) Guide businesses to fully incorporate consumer feedback and suggestions to collaboratively develop exemplary revitalization plans for industrial heritage sites, and provide appropriate incentives to businesses that actively participate in the revitalization of industrial elements and digital-smart transformation.

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