Post-occupancy Evaluation of Yan'an Revolutionary Site from the visitors’ perspective based on multivariate statistical analysis

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Abstract. Taking the Yan'an Revolutionary site as the research object, constructing an evaluation indexes system, collecting data onto the three nationally famous Yan'an Revolutionary sites in Zaoyuan, Yangjialing and Wangjiaping, and using multivariate statistical analysis methods of post-use evaluation research. Factor analysis proves that the Yan'an Revolutionary Site Exhibition and Evaluation System is basically correct. One-way ANOVA tests analysis shows that people of different ages have significant differences in the five indicators in supporting services, the four indicators in the environment, all the indicators for auxiliary display, and the four indicators displayed by the main body. In addition, the higher the educational background, the more significant the difference in the four indicators of supporting services. The results of random forest algorithm analysis of evaluation indicators and overall satisfaction in the Yan'an Revolutionary Site show that there are four out of eight indicators for supporting services; four out of ten indicators for main display; two out of five indicators for auxiliary display items; two of the seven indicators of environmental atmosphere, these indicators have a great impact on the overall satisfaction from visitors.

1. Introduction

Yan'an is a world-famous Chinese revolutionary sacred place, and now it has become the most famous and richest red tourism resource in China. However, in recent years, as more and more visitors choose to receive red education at the revolutionary site, while paying more attention to the display of the revolutionary site, they also put forward newer and higher requirements for the display level of the Yan'an revolutionary site. In addition, the rapid development of Yan'an urbanization has brought many problems with the protection planning of the old revolutionary site in Yan'an. Improper protection and management of the old site and frequent conflicts between the surrounding area and the old site for development space have broken the original growth of the old revolutionary site surroundings. At present, there have been many researches on red tourism, but they are basically the discussion of "tourism management " and other related majors, while the research from the direction of architecture and landscape majors is rare.
This article adopts the Post-occupancy Evaluation of the built environment, takes the Yan'an revolutionary site as the research object, and aims at the satisfaction from the revolutionary site's display. By constructing an evaluation index system, it collects three nationally-known national landmarks: Zaoyuan, Yangjialing and Wangjiaaping. The data onto the Yan'an Revolutionary Sites are used for post-use evaluation research using multivariate statistical analysis methods. The results will have a certain guiding effect on the improvement in the Yan'an Revolutionary Sites' display and future sustainable development. At the same time, they will strive to provide the design, planning and construction provide theoretical basis.

2. Construction of Evaluation Index System

In order to construct a relatively complete post-use evaluation system for the display of the Yan'an Revolutionary site. First, through pilot exploration and field investigation, we roughly understand the content related to the architectural space, surrounding environment and landscape among the issues that users are concerned about, which are summarized as follows four aspects: the main display facility of the revolutionary site, the auxiliary display facility of the revolutionary site, the architectural environment atmosphere of the revolutionary site, and the supporting service facilities of the revolutionary site.

On the basis of pilot exploration and field research, refer to the literature related to the display of the revolutionary site, post-use evaluation, including the construction of the post-use evaluation system, the building of the revolutionary site, planning and protective display, official documents and laws and regulations. Absorbing the advantages of different evaluation systems and indicators, using the Analytic Hierarchy Process, a more comprehensive and targeted evaluation index set is initially constructed, which includes four major aspects: the first is the main body display, which mainly includes two factors: the ontology of the old site and the way of display. The second is auxiliary display, which mainly includes two element layers: service center and landscape sketches. The third is the environmental atmosphere, which mainly includes three factors: the historical environmental atmosphere, the internal environment of the old site, and the peripheral surrounding environment. The fourth is supporting facilities, which mainly include two factor layers of identification and accessibility and public service facilities. There are several index levels under each factor level, and finally a preliminary set of evaluation index sets for the satisfaction from the protective display of the Yan'an Revolutionary site is constructed.

After initially determining the user satisfaction evaluation system displayed on the Yan'an Revolutionary Site, the author designed and conducted a questionnaire survey, the purpose of which is to investigate the importance and necessity of various indicators in the system. The inquiries include visitors to the revolutionary site, management, and experts and scholars related to the field. The questionnaire uses the Likert scale method. There are five grades in scoring standards, which are specifically presented as very important, important, general, unimportant, and very unimportant. The corresponding score of each level decrease of 5 to 1 in order. Among them, 16 valid questionnaires were returned by visitors and 7 valid questionnaires by experts. The total number of samples are 23. The questionnaire was collected and sorted out, and the reliability of the questionnaire was first verified. The Cronbach coefficient of the questionnaire is 0.896, and the standardized Cronbach coefficient is 0.898. It can be seen that the coefficient after standardization is basically equal to the coefficient before standardization. The Cronbach's coefficient after the standard is greater than 0.8, indicating a good internal consistency. Based on social survey items, the reliability of this questionnaire can be passed. According to the results of the questionnaire, 30 indicator-level factors were finally determined. The specific content is shown in the following table (Table 1):

| Target layer | Criterion layer | Factor layer | Index layer | Number |
|--------------|-----------------|--------------|-------------|--------|
| Satisfaction Evaluation of A: | A1 Former site | A11 The original building maintenance status | X1 |
3. Analysis of data samples
After finalizing the indicator set of the post-use evaluation system displayed on the Yan'an Revolutionary Site, the author designed and conducted the second questionnaire survey. Through the visitors' satisfaction with the display of the three nationally famous Yan'an Revolutionary sites in Zaoyuan, Yangjialing and Wangjiaping. The questionnaire also uses the Likert scale method. There are 5 grades in scoring standards, which are specifically presented as very satisfied, satisfied, average, dissatisfied, and very dissatisfied. The corresponding score of each level decreases in 5 to 1 in order. 300 questionnaires were distributed in Zaoyuan, Yangjialing and Wangjiaping, and 275 valid questionnaires were recovered. The effective questionnaire recovery rate reached 91.6%, of which Zaoyuan, Yangjialing and Wangjiaping was 119, 81 and 79 respectively.

The statistical tool SPSS25.0 was used for data analysis in this study. First, through descriptive analysis, the general characteristics of the survey sample were obtained, and then the common factors were extracted by factor analysis, and the orthogonal rotation method was used to maximize the variance of the extracted common factors. The factors are rotated to determine the common components of the influencing factors of satisfaction and verify the accuracy of the constructed index system; thirdly, the t-test and single-factor coefficient of variation analysis are used to analyze the behavior characteristics, demographic characteristics and differential analysis of the influencing factors.
factors of satisfaction; finally, using the random forest in the intelligent machine learning algorithm, establish the evaluation index of the Yan'an Revolutionary site and the classification model of visitor satisfaction, analyse the internal mapping relationship between them, and observe each The importance of the impact of the indicators on satisfaction.

3.1. Demographic characteristics of survey subjects
From the perspective of gender composition, men accounted for 63.3% and women accounted for 36.7%, indicating that men were the main market among visitors to the Yan'an Revolutionary Site. In the age structure, the majority of visitors are 20-30 years old (49.5%), and the proportion of other age groups are not high. This shows that the visitors to the three famous revolutionary sites in Yan'an are mainly young people. From the perspective of educational level, colleges and undergraduates are the main ones, accounting for 65.3% of the total, followed by postgraduate tourists, indicating that visitors are mainly high-literate tourists. Judging from the way of visiting, groups organized by units accounted for 63.6%. From the analysis of age and visiting methods, many units organize young people to visit the old revolutionary sites in Yan'an and receive education and study of revolutionary history. How to attract more individual visitors from other age groups of the future is an important task for the Yan'an Revolutionary Site.

3.2. Means of indicators and analysis of variance
According to the scoring results, the average value of each index is calculated, and the following graph is obtained (Figure 1). The three types of the lowest average score are: B12 Accessibility facilities, A24 Modern technology, and B13 Interactive experience activities. It shows that visitors are the most dissatisfied with the "auxiliary function facilities", "application of modern technology" and "interactive experience activities" of the three Yan'an revolutionary sites. The "C21 Cleanliness", "A11 The original building maintenance status", and "A12 Architectural age characteristics" are in the top three rankings with the highest satisfaction, indicating that the site has achieved good recognition in these aspects.

![Figure 1. Analysis of the average value of each evaluation index](image-url)

From the variance statistics of all 30 indicators by SPSS software, it can be seen that the score gap between each indicator fluctuates significantly. Among them, the top three with the largest variance are: B12 Accessibility facilities, A24 Modern technology and B13 Interactive experience activities. It shows that visitors have different attitudes to Yan'an, the three famous revolutionary sites in the country, in these three aspects, and the difference in satisfaction is the biggest.
3.3. Factor Analysis of Influencing Factors of Visitor Satisfaction

Use SPSS25.0 statistical analysis software to perform principal component factor analysis on the original data. It can be seen from Table 2 that the Butler sphere test value is equal to 11321.561, which reaches a significant level under the condition of 435 degrees of freedom and the level of 0.00, indicating that there are common factors among the correlation matrices of the tourist satisfaction evaluation items in the red tourist attractions, which are suitable Perform factor analysis; the KMO statistic value is 0.974, which is greater than 0.7, indicating that the effect of factor analysis is better.

Secondly, in order to improve the results of factor analysis, we must first check the degree of commonality of each descriptive item. Generally speaking, the effect of factor analysis with a degree of commonality greater than 0.4 is ideal, and the degree of commonality in this questionnaire is greater than 0.4. The common factors are extracted by the method of principal component extraction and the variance is maximized. According to the principle that the satisfaction evaluation factor set is divided into four aspects, a total of 4 common factors are extracted, and the cumulative explained variance is 82.62%. That is, 4 common factors explain 82.62% of the total variation.

The information contained in the common factor can be explained by analysing the high-load evaluation index contained in each common factor. As shown in Table 2, the first five high-load evaluation indicators included in common factor 1 are shown as: D Supporting services, and the first five high-load evaluation indexes included in common factor 2 are shown as: A Main part display, The first five high-load evaluation indicators included in common factor 3 are shown as: B Auxiliary display, and the first five high-load evaluation indexes included in common factor 4 are shown as C Atmosphere. The above analysis further proves that the Yan'an Revolutionary Site Exhibition Evaluation Index System constructed in this article is basically correct. At the same time, some places need to be further fine-tuned, such as: "A24 Modern technology" and "A25 Display content update" Included in B: Auxiliary display, etc. In addition, Cronbach's alpha coefficient is used to test the reliability of the scale. The overall Cronbach's alpha coefficient value is 0.987, and Cronbach's alpha coefficient values within the four factors are all greater than 0.7, indicating that the reliability of the data is high.

| Extraction common factor | Evaluation index items                        | Factor load | Eigenvalues | Variance contribution rate | Reliability |
|--------------------------|-----------------------------------------------|-------------|-------------|-----------------------------|-------------|
| Common factor one: D Supporting service | D15 Parking | 0.763 | 8.168 | 27.227 | 0.972 |
|                          | D16 Public transportation | 0.761 | | | |
|                          | D14 Direction signs | 0.732 | | | |
|                          | D22 Public toilet | 0.701 | | | |
|                          | D11 Roads | 0.691 | | | |
| Common factor two: A Main part display | A13 Exhibition and decoration of cultural relics | 0.807 | 6.604 | 22.014 | 0.964 |
|                          | A12 Architectural age characteristics | 0.790 | | | |
|                          | A11 The original building maintenance status | 0.773 | | | |
|                          | A22 Categories and layout of cultural relics exhibition | 0.712 | | | |
|                          | A21 Streamline organization | 0.660 | | | |
| Common factor            | A24 Modern technology | 0.774 | 6.333 | 21.109 | 0.948 |
|                          | A25 Display content | 0.730 | | | |
three: 
B Auxiliary display
update
B12 Accessibility facilities 0.691
B13 Interactive experience activities 0.689
B11 Direct service facilities 0.604

Common factor four:
C Atmosphere
C1 Historical atmosphere of the overall environment 0.563
C21 Cleanliness 0.633 3.681 12.272 0.954
C31 Surrounding landscape 0.547
C12 Display of historical fragments 0.543
A26 Highlight the theme 0.475

3.4. Analysis of the difference in visitor characteristics
Independent sample t test and single factor ANOVA test were used to analyse the difference between the demographic characteristics of visitors and the satisfaction evaluation index of Yan'an Revolutionary Site. The results found that the independent sample t-test has no significant difference in the satisfaction evaluation of the various indicators displayed on the Yan'an Revolutionary Site in terms of gender and visiting methods (group organization, individual self). One-factor ANOVA test can be seen in terms of age, and the five indicators of D supporting services (D13 Accessible transportation, D14 Direction signs, D15 Parking, D16 Public transportation, D21 Rest and shade facilities), Four indicators of C environment atmosphere (C22 Commentary signs, C31 Surrounding landscape, C32 Surrounding building volume, C33 Service facilities), all indicators for auxiliary display of B, and 4 indicators for main display of A (A24 Modern technology, A25 Display content update, A27 Reasonable content) There are significant differences, as the age increases, the attention to the above indicators gradually increases, especially for those over 50 years old. The single-factor ANOVA test shows that the four indicators of D supporting services (D13 Accessible transportation, D16 Public transportation, D21 Rest and shade facilities, and D22 Public toilet) have significant differences in terms of education level, indicating that the higher the level of education High attention to D supporting services.

3.5. Analysis of the relationship between evaluation indicators and satisfaction
The results of the analysis provide two measures of importance. The first one is "%IncMSE", that is: increase in MSE (increase in mean squared error). The larger the value, the greater the importance of the variable. Another result is "IncNodePurity" (increase in node purity increases node purity). The larger the value, the greater the importance of the variable. Table 3 shows the importance ranking results of the two indicators provided by "%IncMSE" and "IncNodePurity", although there are certain differences in their rankings. However, the general trend is basically close (Figure 2). From the correlation coefficients, it can be seen that the top ten of the 30 indicators are listed. Among the eight indicators of D supporting services, there are "D22 Public toilet" and " D21 Rest and shade facilities ", " D11 Roads " and " D16 Public transportation " four items; Main part display of the ten indicators are " A12 Architectural age characteristics ", " A13 Exhibition and decoration of cultural relics "There are four items."A27 Reasonable content". and"A22 Categories and layout of cultural relics exhibition"; B among the five indicators of auxiliary display are "B21 Sculptures, sketches, monuments". and " B11 Direct service facilities ", two; C Environment In terms of atmosphere, the seven indicators include " C12 Display of historical fragments " and " C31 Surrounding landscape ". These indicators have a
great impact on the overall satisfaction of visitors. Therefore, the Yan'an Revolutionary Site Exhibition should be improved or paid more attention to in these aspects.

Figure 2. Analysis of the importance of various evaluation indicators

4. Conclusion and suggestion

Through the above research, the factor analysis result of the visitor satisfaction evaluation of the Yan'an Revolutionary Site Exhibition further proves that the evaluation index system of the Yan'an Revolutionary Site Exhibition constructed in this article is basically correct. At the same time, some places need further fine-tuning. Through independent sample t-test and single-factor ANOVA test analysis on the data, it is shown that people of different ages among the visitors have a test of five indicators in supporting services, four indicators in the environment, all indicators for auxiliary display, and main display. There are significant differences in the four indicators of. The results show that as the age grows, the attention to the above indicators gradually increases, especially for the age group over 50. In addition, in terms of education level, it was also found that the higher the educational background, the more significant the difference in the four indicators of supporting services, indicating that visitors with higher education have a higher demand for supporting services displayed on the Yan'an Revolutionary Site. The results of random forest algorithm analysis of evaluation indicators and overall satisfaction of Yan'an Revolutionary Sites show that there are four out of eight indicators for supporting services; four out of ten indicators for main display; two out of five indicators for auxiliary display; There are two out of the seven indicators of environmental atmosphere, these indicators have a great impact on the overall satisfaction of visitors. Therefore, the Yan'an Revolutionary Site is required to show greater improvement or attention to these aspects.

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