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Evaluation Method of Government Website Based on Fuzzy Analytic Hierarchy Process

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Abstract

With the development of Internet-based applications, an era of big data brings changes in the field of information management. In the new era, "Internet + government services" is the necessary course of the digital government and the inevitable choice of the service-oriented government. This article focuses on developing a more effective evaluation method for the construction of government affairs websites. A comprehensive evaluation method based on the fuzzy hierarchy process (AHP) is introduced and applied to the analysis of a government portal website in Leshan, a major city in Southwest China. The proposed method incorporates the index system developed by the government and adjusts index weights based on actual local conditions, which has shown outperformed to both the simple weighted-sum method and the traditional AHP method.

Keywords

Fuzzy level; Digital government; Government website.

1. INTRODUCTION

Due to the rapid development of Internet information technology and the increasing Internet penetration rate in the 21st century, the number of Chinese Internet users has reached 845 million. From simple information virtualization, to chaotic information bombardment, and then to the macro era of big data, we have fully stepped into the "Internet +" era. In the field of government affairs, "Internet + government services" has emerged at this historic moment, which is not only a reform of tools and means, but also an innovation of ideas and consciousness. Only by integrating the technical system of e-government with the work of relevant government departments can the transformation of government functions and the matching of citizen discourse be realized. The new management and service model relies on the necessary online carrier -- government website. In the era of big data, the government website is part of a complete government structure and acts as a bridge for communication between the government and citizens. On the one hand, it improves the efficiency and work quality of the government and is conducive to the construction of a service-oriented government. On the other hand, it faces numerously new challenges. Government information and public interests are threatened from the world, which puts forward higher standards for the security and authority of websites [2].

Therefore, in order to ensure that the government website continues to improve its functions and provide services, regular measurement and evaluation are particularly important. In the digital construction phase of the government, various indicators and systematical measures of web site constructions have been developed, but many of them lack general applicability. Although the indices came from samples extracted from many sites, they often do not match with specific evaluation scenarios and the index weight deviation does not fit the evaluation

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requirement. In particular, for the local government site is concerned, some of the sites contain featured contents but lack of sufficient resource support while some are out of date but poured in excessive energy, a fundamental mismatch between the functionality of the site and its index.

Therefore, based on the concretization of website indicators, this paper innovatively applies the fuzzy analytic hierarchy process (AHP) to conduct website evaluation. What needs to be clear is that the evaluation index of the website is a fuzzy concept, and the evaluation of the website is a multi-factor process. The complex process of multi-index and multi-objective can not be explained by the traditional assignment and weighting only, which fail to address the ambiguity and uncertainty of the boundary of the evaluation and grading of the effectiveness of websites [3]. On the basis of fuzzy theory, this paper introduces AHP, from "China digital government service capability assessment report (2019 edition), the architecture of index system, and selects Leshan city government portal website as the object of evaluation. The proposed method calculates the comprehensive level of real demand, makes adjustments of the function of the local habits index, and manifests the preferences and habits into the hierarchical analysis matrix, comprehensive adjustment goal and the reality demand, in order to obtain the most suitable evaluation for the local index evaluation system. Using AHP can also quantitively address complex evaluation requirements, and solve the mismatch problem of the membership degree and weight.

2. ESTABLISHMENT OF FUZZY ANALYTIC HIERARCHY PROCESS MODEL

2.1. Establish the Evaluation Method Index System

In this paper based on the digital government report about the "local government website performance evaluation index system of" three-level index system, consulting professional instructor of e-government, web site, the performance evaluation of specialists and leshan local site operations staff, in consideration of the functionality of the site completeness, practicality and effectiveness, on the basis of evaluation of the integrated reorganization, generate table 1 leshan government portal website evaluation index system and rating standard. [4]

The index system in Table 1 is divided into two levels. The first level is: $U = \{U_1,u_2,u_3,u_4,u_5,u_6\}$, where u_1: Information release, U_2: Interpret response, U_3: House service, U_4: Interactive communication, U_5: Management Guarantee, U_6: Function promotion. The factor distribution of the second level is as follows: $U_1=\{u_1^1, u_1^2, u_1^3, u_1^4, u_1^5\}$, where u_1^1: Basic information disclosure, U_1^2: Information disclosure in key areas, u_1^3: Center work implementation publicity, U_1^4: Data openness, U_1^5: Public safeguards;$u_2=\{u_2^1, u_2^2\}$, u_2^1: Policy Interpretation, U_2^2: to respond to concerns;$u_3=\{u_3^1, u_3^2, u_3^3\}$, u_3^1: Service content, u_3^2: service function;u_3^3: Integrated package service; $u_4=\{u_4^1, u_4^2\}$, u_4^1: Consultation Complaints, U_4^2: Solicitation survey;$u_5=\{u_5^1, u_5^2, u_5^3\}$, u_5^1: Design specification, u_5^2: institutional guarantee;u_5^3: operation and maintenance guarantee;$u_6=\{u_6^1, u_6^2, u_6^3\}$, u_6^1: application function, u_6^2: IPv6 access;u_6^3: User space.

The evaluation level is divided into five, that is, the evaluation set $V=\{V_1, v_2, v_3, v_4, v_5\}$, where v_1: the stage of High excellence;v_2: the stage of Distinction;v_3: the stage of Good;v_4: the Developing Stage;v_5:the Initial Stage. In order to fully realize the quantification, the rating of the comment set is quantified with the 100-point system, and then the weighted average of the results is carried out to get the total score of the evaluation. Table 2 is obtained using the percentage scale referred to in the Digital Government Report.

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Table 1. Index system and grade standard table of Leshan government portal website evaluation

Evaluation factors		Judge level				
		High excellence(v_1)	Distinction(v_2)	Good(v_3)	Developing Stage(v_4)	Initial Stage(v_5)
The information release	Disclosure of Basic Information	v_1	v_2	v_3	v_4	v_5
	Information disclosure in key areas	v_1	v_2	v_3	v_4	v_5
	Center work implementation publicity	v_1	v_2	v_3	v_4	v_5
	Open data	v_1	v_2	v_3	v_4	v_5
	Public security	v_1	v_2	v_3	v_4	v_5
Interpretation of the response	Policy interpretation	v_1	v_2	v_3	v_4	v_5
	In response to concerns	v_1	v_2	v_3	v_4	v_5
Business services	The service content	v_1	v_2	v_3	v_4	v_5
	The service function	v_1	v_2	v_3	v_4	v_5
	Integrated Package Service	v_1	v_2	v_3	v_4	v_5
interactive	Consulting the complaint	v_1	v_2	v_3	v_4	v_5
	For investigation	v_1	v_2	v_3	v_4	v_5
Management of security	The design specification	v_1	v_2	v_3	v_4	v_5
	Institutional guarantee	v_1	v_2	v_3	v_4	v_5
	Operational security	v_1	v_2	v_3	v_4	v_5
Function to promote	Application functions	v_1	v_2	v_3	v_4	v_5
	IPv6 access	v_1	v_2	v_3	v_4	v_5
	The user space	v_1	v_2	v_3	v_4	v_5

Table 2. A list of grades and corresponding scores

Evaluation results	High excellence	Distinction	good	Developing Stage	Initial Stage
score	100	90	80	70	60

2.2. Determination of the Weight of Each Factor

The Analytic Hierarchy Process (AHP) is adopted to determine the relative proportion of each index above, namely the weight. The principle of the Process is to decompose the problem into some components for a complex multi-criteria decision making problem, and the subordinate relationship of these elements forms a hierarchical structure reflecting the connection between the elements.Therefore, the analytic hierarchy process needs to construct a paired comparison matrix on the constructed hierarchical structure model, and then carry out the hierarchical single sorting and hierarchical total sorting respectively, starting from the lower level, so as to achieve the optimization of the overall evaluation effect.

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The first is to build a hierarchical structure model. It is known that our ultimate goal is to measure the performance of Leshan Municipal Government Portal Website, among which the intermediate elements consist of two layers of structure (U), and the final plan is to obtain the evaluation level (V) of the website.From this, we can construct the hierarchical model of Figure 1.

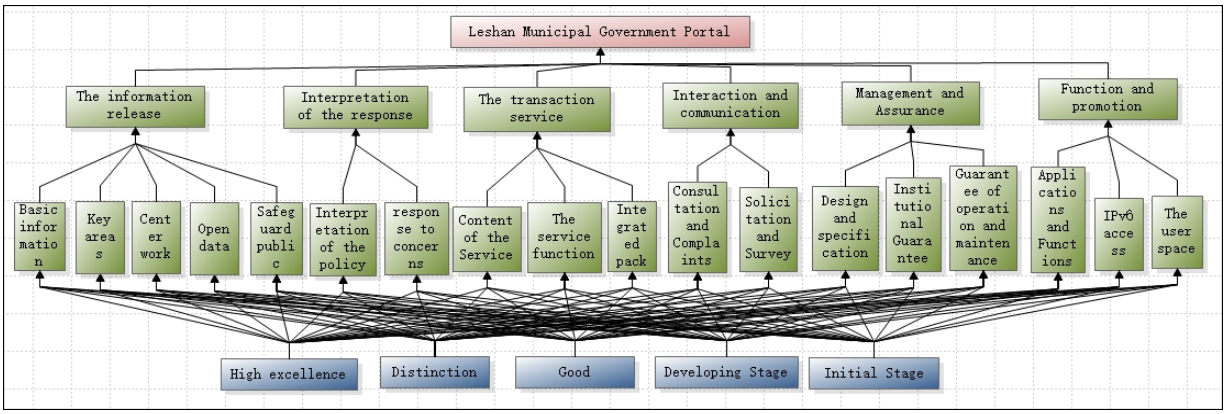

Figure 1. Hierarchical structure model of Leshan municipal government portal website evaluation

Secondly, the hierarchical structure model is disassembled to obtain multiple pair comparison matrices, and the factors are decomposed layer by layer. In this step, the index weight of each level is only needed to be established without the need for the final evaluation and analysis, so a total of 7 paired comparison matrices can be split.In the specific paired comparison, we take the advice on the proportion of indicators in the authoritative Digital Government Report and the guidance of Leshan local government with its local characteristics as the common basis to comprehensively obtain the importance ratio among elements.

Matrix 1: Layer 1 factor set. The importance of the six factors of information release, interpretation and response, service, interaction and communication, management guarantee and function promotion relative to Leshan City portal website is shown in Table 3.

Table 3. Relative importance of each factor in the first layer

U	u_1	u_2	u_3	u_4	u_5	u_6
u_1	1	4	3	1	3	2
u_2	1/4	1	1	1/3	1/2	1/2
u_3	1/3	1	1	1/2	1	1/2
u_4	1	3	2	1	2	2
u_5	1/3	2	1	1/2	1	1
u_6	1/2	2	2	1/2	1	1

According to the calculation of weight W= (0.3006, 0.0776, 0.0988, 0.2512, 0.1237, 0.1482), λmax= 6.0748, CI=0.01496, RI=1.24, CR=0.0119<0.1, the judgment matrix has consistency.

Matrix 2: Information distribution factor set. The importance of basic information disclosure, disclosure of key areas, implementation of central work, data openness, and disclosure guarantee relative to information release is shown in Table 4.

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Table 4. Relative importance of information release factor set

u_1	u_1^1	u_1^2	u_1^3	u_1^4	u_1^5
u_1^1	1	1/2	1	1	1
u_1^2	2	1	2	2	3
u_1^3	1	1/2	1	1	1
u_1^4	1	1/2	1	1	1
u_1^5	1	1/3	1	1	1

The weight is calculated which shows W_1 =(0.1636, 0.3574, 0.1636, 0.1636, 0.1517), λmax: 5.0198, CI=0.00495, RI=1.12, CR=0.0044<0.1,the judgment matrix has consistency.

Matrix 3: Interpret the response factor set. The importance of policy interpretation and response to concerns is two factors relative to the interpretation of response factor set, as shown in Table 5.

Table 5. Relative importance of interpretative response factor sets

u_2	u_2^1	u_2^2
u_2^1	1	2
u_2^2	1/2	1

The weight is calculated which shows W_2 =(0.6667, 0.3333), since it belongs to the second-order pairwise comparison matrix, it must be consistent, and no separate test is needed.

Matrix 4: Interactive communication factor set. The importance of the two factors of solicitation, investigation and consultation and complaint relative to the interactive communication factor set is shown in Table 6.

Table 6. Relative importance of interactive communication factor sets

u_4	u_4^1	u_4^2
u_4^1	1	1
u_4^2	1	1

The weight is calculated which shows W_4 =(0.5,0.5), since it belongs to the second-order pairwise comparison matrix, it must be consistent, and no separate test is needed.

Matrix 5: Emission service factor set. The importance of service content, service function and integrated package service in relation to the service factor set is shown in Table 7.

Table 7. Relative importance of service factor set

u_3	u_3^1	u_3^2	u_3^3
u_3^1	1	2	1
u_3^2	1/2	1	1/2
u_3^3	1	2	1

The weight is calculated which shows W_3 =(0.4000, 0.2000, 0.4000), λmax=3.0000,

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CI=0, RI=0.58, CR=0<0.1, the judgment matrix has consistency.

Matrix 6: Feature promotion factor set. The importance of application function, IPv6 access, and user space in relation to the feature promotion factor set is shown in Table 8.

Table 8. Relative importance of function promotion factor sets

u_6	u_6^1	u_6^2	u_6^3
u_6^1	1	4	4
u_6^2	1/4	1	1
u_6^3	1/4	1	1

The weight is calculated which shows W_6 =(0.6667, 0.1667, 0.1667), λmax=3.0000,

CI=0, RI=0.58, CR=0<0.1, the judgment matrix has consistency.

Matrix 7: Management assurance factor set. The importance of design specification, system guarantee and operation and maintenance guarantee relative to the management guarantee factor set is shown in Table 9.

Table 9. Relative importance of management assurance factor sets

u_5	u_5^1	u_5^2	u_5^3
u_5^1	1	1/2	1
u_5^2	2	1	1
u_5^3	1	1	1

The weight is calculated which shows W_5 =(0.2599, 0.4126, 0.3275), λmax=3.0536, CI=0.0268, RI=0.58, CR=0.0516<0.1, the judgment matrix has consistency.

2.3. Fuzzy Comprehensive Evaluation Model of Website Evaluation

Fuzzy comprehensive judgment decision is a process of making a comprehensive evaluation of things affected by many factors and finally realizing multi-factor decision. For different types of evaluation objects, there are also differences in the applicable operators. The commonly used operators are M ($\wedge, \vee$) operator, M ($\cdot, \vee$) operator, M ($\wedge, \oplus$) operator and M ($\cdot$, +) operator.Among them, the weighted average M ($\cdot, \vee$) operator is more accurate, which is suitable for comprehensive evaluation of the whole and its relationship with various factors.In this assessment in the process of government affairs website, multiple levels of index factor, number, their respective standard values differ, the evaluation matrix needs to reflect the unity of the assessment process standards, combined with the test site of the target in order to obtain the overall evaluation effect, this article selects the weighted average model M ($\cdot$, $\vee$) operator for further comprehensive evaluation.

3. ASSESSMENT APPLICATION BASED ON LESHAN MUNICIPAL GOVERNMENT PORTAL WEBSITE

In an e-government classroom activity, a total of 66 people participated in the evaluation of "Leshan Municipal Government Portal Website", and combined with the five evaluation levels proposed by "Digital Government Report" to score the effect, thus generating the comprehensive evaluation statistics of the website, as shown in Table 10.

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(According to the assessment results, the 2019 Digital Government General Report divides the digital government service capability into five levels, namely, the level of High excellence (above 95 points, including 95 points), the level of Distinction (between 85 points and 95 points, including 85 points), the level of good(between 75 points and 85 points, including 75 points), and the Developing Stage (between 60 points and 75 points, including 60 points) and the Initial Stage (below 60 points).)

Table 10. Comprehensive evaluation statistical data of Leshan government portal

Evaluation factors		High excellence	Distinction	Good	Developing Stage	Initial Stage
The information release	Disclosure of Basic Information	0.20	0.60	0.20	0.00	0.00
	Information disclosure in key areas	0.40	0.27	0.27	0.07	0.00
	Center work implementation publicity	0.00	0.20	0.60	0.20	0.00
	Open data	0.13	0.47	0.40	0.00	0.00
	Public security	0.40	0.40	0.20	0.00	0.00
Interpretation of the response	Policy interpretation	0.00	0.20	0.40	0.40	0.00
	In response to concerns	0.00	0.80	0.20	0.00	0.00
Business services	The service content	0.60	0.27	0.13	0.00	0.00
	The service function	0.20	0.20	0.50	0.10	0.00
	Integrated Package Service	0.00	0.60	0.20	0.20	0.00
interactive	Consulting the complaint	0.00	0.80	0.20	0.00	0.00
	For investigation	0.00	0.20	0.50	0.30	0.00
Management of security	The design specification	0.80	0.20	0.00	0.00	0.00
	Institutional guarantee	0.07	0.33	0.20	0.40	0.00
	Operational security	0.20	0.30	0.30	0.20	0.00
Function to promote	Application functions	0.00	0.30	0.30	0.40	0.00
	IPv6 access	0.20	0.20	0.00	0.60	0.00
	The user space	0.00	0.00	0.20	0.80	0.00

The information release factor set was comprehensively evaluated, and the single-factor evaluation matrix was

$$R_1=\begin{pmatrix}0.20 & 0.60 & 0.20 & 0.00 & 0.00\\ 0.40 & 0.27 & 0.27 & 0.07 & 0.00\\ 0.00 & 0.20 & 0.60 & 0.20 & 0.00\\ 0.13 & 0.47 & 0.40 & 0.00 & 0.00\\ 0.40 & 0.40 & 0.20 & 0.00 & 0.00\end{pmatrix}$$, W_1 =(0.1636, 0.3574, 0.1636, 0.1636, 0.1517), and M (·,∨) was used to calculate:

$B_1=W_1 \circ R_1$=(0.2582 0.3632 0.3220 0.0565 0.0000).

Comprehensive evaluation was made for the interpretation response factor set, and the single factor evaluation matrix was

$$R_2=\begin{pmatrix}0.00 & 0.20 & 0.40 & 0.40 & 0.00\\ 0.00 & 0.80 & 0.20 & 0.00 & 0.00\end{pmatrix}$$, W_2 =(0.3333, 0.6667), and M (·,∨) was used to calculate:

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$B_2=W_2 \circ R_2=(0.0000 \quad 0.4000 \quad 0.3333 \quad 0.2667 \quad 0.0000)$.

Comprehensive evaluation is made for the service factor set, and the single factor evaluation matrix is

$R_3=\begin{pmatrix} 0.60 & 0.27 & 0.13 & 0.00 & 0.00 \\ 0.20 & 0.20 & 0.50 & 0.10 & 0.00 \\ 0.00 & 0.60 & 0.20 & 0.20 & 0.00 \end{pmatrix}$, $W_3=(0.4000, 0.2000, 0.4000)$, and M $(\cdot, \vee)$ was used to calculate:

$B_3=W_3 \circ R_3=(0.2800\ 0.3867\ 0.2333\ 0.1000\ 0.0000)$.

The interactive communication factor set was comprehensively evaluated, and the single factor evaluation matrix was

$R_4=\begin{pmatrix} 0.00 & 0.80 & 0.20 & 0.00 & 0.00 \\ 0.00 & 0.20 & 0.50 & 0.30 & 0.00 \end{pmatrix}$, $W_4=(0.5,0.5)$, and M $(\cdot, \vee)$ was used to calculate:

$B_4=W4 \circ R_4=(0.0000 \quad 0.5000 \quad 0.3500 \quad 0.1500 \quad 0.0000)$.

Comprehensive evaluation is made for the management assurance factor set, and the single factor evaluation matrix is

$R_5=\begin{pmatrix} 0.80 & 0.20 & 0.00 & 0.00 & 0.00 \\ 0.07 & 0.33 & 0.20 & 0.40 & 0.00 \\ 0.20 & 0.30 & 0.30 & 0.20 & 0.00 \end{pmatrix}$, $W_5=(0.2599, 0.4126, 0.3275)$, and M $(\cdot, \vee)$ was used to calculate:

$B_5=W_5 \circ R_5=(0.3009 \quad 0.2878 \quad 0.1808 \quad 0.2305 \quad 0.0000)$.

The function promotion factor set is comprehensively evaluated, and the single factor evaluation matrix is

$R_6=\begin{pmatrix} 0.00 & 0.30 & 0.30 & 0.40 & 0.00 \\ 0.20 & 0.20 & 0.00 & 0.60 & 0.00 \\ 0.00 & 0.00 & 0.20 & 0.80 & 0.00 \end{pmatrix}$, $W_6=(0.6667, 0.1667, 0.1667)$, and M $(\cdot, \vee)$ was used to calculate:

$B_6=W_6 \circ R_6=(0.0333 \quad 0.2334 \quad 0.2334 \quad 0.5001 \quad 0.0000)$.

Finally, comprehensive evaluation is made on the first layer factors, and the corresponding single factor evaluation matrix is

$R=\begin{pmatrix} 0.2582 & 0.3632 & 0.3220 & 0.0565 & 0.0000 \\ 0.0000 & 0.4000 & 0.3333 & 0.2667 & 0.0000 \\ 0.2800 & 0.3867 & 0.2333 & 0.1000 & 0.0000 \\ 0.0000 & 0.5000 & 0.3500 & 0.1500 & 0.0000 \\ 0.3009 & 0.2878 & 0.1808 & 0.2305 & 0.0000 \\ 0.0333 & 0.2334 & 0.2334 & 0.5001 & 0.0000 \end{pmatrix}$, $W=(0.3006, 0.0776, 0.0988, 0.2512, 0.1237, 0.1482)$, and M $(\cdot, \vee)$ was used to calculate:

$B=W \circ R=(0.1474 \quad 0.3742 \quad 0.2906 \quad 0.1879 \quad 0.0000)$.

Finally, the comprehensive evaluation results show that the overall evaluation situation of Leshan government portal website is as follows: 14.74% belongs to the level of "High Excellence", 37.42% belongs to the level of " Distinction", 29.06% belongs to the level of " Distinction", 18.79% belongs to the level of " Distinction".

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Combining the evaluation grade with the corresponding score (Table 2), the total evaluation score (in the percentage system) can be obtained as: P=B' °CT=84.81874, where C= (100 90 80 70 60). It can be seen from the evaluation results that the construction of Leshan government portal website belongs to the " Distinction " level according to the principle of maximum membership degree, and 52.16% of the proportion reflects the situation of distinction and good.

4. CONCLUSION

This article applies the fuzzy analytic hierarchy process (AHP), a comprehensive policy documents and the combination of local demands, so as to improve the index weight distribution system and to provide comprehensive evaluation of government affairs website effectiveness. This approach makes us through rigorous to hammer out a review of the Leshan government portal website for the level of " Distinction ", according to the centesimal system belongs to 84.81874 points.This shows that the fuzzy AHP on the site assessment is both feasible and more effective. The method of fuzzy evaluation process with quantitative analysis to ensure the integrity of the whole on enhance the accuracy of the data, and combining with innovatively improved AHP, can also be more scientifically applied on case-by-case basis.

And for this evaluation of the local government portal, we also need to reflect on the effectiveness of its functional structure. Most of the basic government information is complete, column Settings and resource allocation has been in place, but there are still key areas of insufficient publicity drawbacks. On the other hand, the interactive communication section on the municipal government website has the highest membership value, which indicates that it has made a more active attempt to build communication channels and promote the expression of public opinion compared with other parts, which is also a reference for other local governments.

In conclusion, based on the assessment, the fuzzy comprehensive evaluation method of web site to the concrete analysis of local construction situation of digital government, bottlenecks, and various environment, and so on, the corresponding evaluation to dig the real problems, suit the remedy to the case, can also respond to local construction, promoting model to take the lead, for the continuous improvement of the local digital government and government affairs website to provide factual basis.

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