

# Digital Certificates Resource Sharing Service Capability Evaluation

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## Abstract

*The certification resource is a very special class of information resources of the government, which has huge amount of information and frequency usages of government administrative activities. With the various administrative departments' in-depth online approval, there is an urgent demand for certificates information sharing needs, especially in interdepartmental tasks. In this paper, government service capacity evaluation of digital certificates resource sharing is the study object. First we checked literature and questionnaires to establish an evaluation indexes system of digital license resource sharing service capacity. Then we built fuzzy AHP evaluation model to evaluate the ability of the service. Finally we took Beijing Municipal Government Office as the empirical analysis of objects, and got the evaluation result of their digital certificates resource sharing service capacity.*

**Keywords:** digital certificates, evaluation index, Fuzzy AHP evaluation model, sharing service capabilities

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## 1. Introduction

In recent years, the government information resource utilization and sharing has become an important content in the construction of e-government. Government information resources are the important resources in the country which have various forms and extremely widespread contents [1].

Certification is the important results and basic information for government to carry out all kinds of administrative activities. Mainly refer to all levels in accordance with the law of administrative licensing items and the result of the approval of the examination and approval matters and documents. Digital certification is a kind of digital way that is generated in accordance with the standard content and format, which is an effective way to resolve the difficulty to print certificate. He FQ, [2] shows that digital certificates resources sharing under the network environment ability evaluation is multiple in dimensions and stratified. The results of other studies, [3-5] showed that because of the economic, institutional, legal, standardized and security aspects of reasons, information resources sharing of the digital certificate is slow in the process. How to break the deadlock and quickly push government digital certificate information resource utilization and sharing so as to really improve the efficiency of government services and level has become a pressing research topic.

## 2. Digital Certificates Resource Sharing Service Capability Evaluation Model

### 2.1. Selection of Evaluation Methods

Comprehensive evaluation has been one of the focus problems in the social sciences, and therefore a variety of corresponding theory and algorithm appear. The analytic hierarchy process (AHP) and data envelopment method, artificial neural network evaluation method, grey comprehensive evaluation method and fuzzy comprehensive evaluation method are more outstanding [6-10].

The main advantage of analytic hierarchy process (AHP) is that it is practical, systematic, and simplicity. The main advantage of fuzzy evaluation method is that it's easy and feasible, especially in some problem where quantity analysis is unavailable in traditional view, and it perfectly solves the problem of the fuzziness and uncertainty of judgment that shows the application prospect of it. Data envelopment analysis (DEA) is applied to performance

evaluation of enterprise information system, but for the e-government system, it is difficult to achieve in our country's electron government affairs environment at present. Evaluation method based on artificial neural network has the advantage of strong applicability, but the disadvantage is that the amount of training samples is huge and the applied range is limited. Gray comprehensive evaluation method has the advantage that its calculation process is simple and reliable. The calculation of grey correlation coefficient used in the method also needs to determine the "resolution coefficient", and the selection of the coefficient does not have a reasonable standard.

By comparing the above five kinds of evaluation methods, the method of combining analytic hierarchy process (AHP) and fuzzy evaluation is selected to evaluate the e-government performance evaluation model based on technology. Specifically, the analytic hierarchy process (AHP) is used to determine the relative weights of various technical indexes of e-government and weights secondary index to the primary index step by step. The fuzzy judgment method is used to evaluate various technical indexes of the electronic government affairs comprehensively.

## 2.2. Fuzzy AHP Model

The specific composition and operation are as follows:

### 1. Factor set

Factor set is a collection of indexes composed of evaluation index and a layered approach is needed to use to solve the problem.

### 2. Weight set

The weight set is a collection of important degree of each index in the index system. The method of determining weight is: according to different evaluation problem, on the basis of comprehensive analysis combined with the experience, using the analytic hierarchy process (AHP), compare the importance of pairing of evaluation index to establish judgment matrix, and then by solving matrix eigenvalue method to work out. Finally, make a consistence check for the above judgment logic consistency inspection. Consistency indexes:  $CI = (\lambda_{\max} - n) / (n - 1) \lambda_{\max}$  is the largest eigenvalue of  $n$  order judgment matrix  $A$ .

### 3. Evaluation set

Evaluation set is a collection that evaluate good or bad of the target. Here do not use generally popular ranking method, such as defining the evaluation as several levels, such as 5 levels (excellent, good, medium, bad, worse), 7 levels (best, very good, good, well, medium and bad, worst), but for according to the weight of various indexes, adopt comprehensive score of gradation that can embody the level difference. Ranking method is based on in specific operation. 9 level, for example, determine the level first, and then grade it according to score range in its grade range. In this paper, five grade method is used to divide evaluation target degree into 5 levels (excellent, good, medium, bad, worse).

That is the evaluation set  $V = \{v_1, v_2, v_3, v_4, v_5\}$ .

### 4. Fuzzy evaluation matrix R to describe fuzzy relations:

$$R = \begin{bmatrix} R_{11} & R_{12} & \dots & R_{1n} \\ R_{21} & R_{22} & \dots & R_{2n} \\ \dots & \dots & \dots & \dots \\ R_{m1} & R_{m2} & \dots & R_{mn} \end{bmatrix} \quad (1)$$

In the matrix,  $R_{ij}$  is introduced to represent the degree of membership of the  $j_{th}$  comment of the  $i_{th}$  evaluation index of the  $k_{th}$  unit. The concrete calculation method of membership degree is that each expert has corresponding evaluation value  $W_{ij}$  to each index for the inspection data of the  $k_{th}$  unit, then  $R_{ij}^k = W_i / \sum W_{ij} (j = 1, 2, \dots, n)$

5. Based on the fuzzy matrix synthesis operation, comprehensive evaluation model expressed as  $B = A \circ R$ ,  $A$  is the vector of primary index weight.

### 3. Empirical Analysis

The general office of the Beijing municipal government electronic government system is the object of empirical study, and the digital certificate resource sharing service ability is researched in this paper.

#### 3.1. Determine of Index Weight

The indexes are get from the papers and questionnaires. Based on the results of the questionnaire, many tables can be made and each table is according to the principle of transformation. Then synthesis judgment matrices of experts (solve arithmetic mean), and final judgment matrix can be concluded, and use the judgment matrix to calculate the weights. As is shown in Table 1.

Table 1. Indexes Weight

Digital Certificates Resource Sharing Service capability evaluation index system	First level indexes		Second level indexes	
	Name	Weight	Name	Weight
	System Construction level C1	0.3015	Leaders' attention degree C11	0.219
			Time and Manpower cost in system constructionC12	0.127
			System error rate C14	0.337
	Equipment support ability C2	0.1732	System expandability C15	0.317
			Per capita number of PC systemC21	0.199
			System server equipment performanceC22	0.207
			network environmentC23	0.306
	Information sharing quality C3	0.1597	Ability of disaster preparedness C25	0.288
			Accuracy of resource acquisition C31	0.244
			Timeliness of resource acquisition C32	0.255
			Definition of digital certificates C34	0.148
	Manpower Resources ability C4	0.3015	Degree of information sharing between departments C36	0.353
			Resource sharing consciousness C41	0.394
			Resource sharing executionC42	0.124
			Popularization rate of information system C43	0.124
			Service attitude C44	0.234
	Organization And management level C5	0.0641	Technical cooperation degreeC45	0.124
			Information sharing system standardization C51	0.378
			Service process standardization C52	0.218
Information management system standardization C53			0.404	

#### 3.2 Service Capability Assessment

This paper randomly selected five experts from more than 20 to mark each index of the unit to be evaluated. Evaluation sets:  $V = \{v1, v2, v3 \text{ and } v4 \text{ and } v5\} = \{\text{outstanding, good, medium, bad, worse}\}$ . Each survey object is required to mark for each index (ten-point system) in the questionnaire. In data processing, the score of each index that marked by each survey object will be substituted respectively into the membership function of the index formula, and calculate the degree  $\mu$  of membership that the object scores to the object, and grade the membership, namely:

- When  $9 < \mu \leq 10$ , named "excellent", and represented by  $\mu_1$ ,
  - When  $7.5 < \mu \leq 9$ , named "good", and represented by  $\mu_2$ ,
  - When  $6 < \mu \leq 7.5$ , named "medium", and represented by  $\mu_3$ ,
  - When  $4 < \mu \leq 6$ , named "bad", and represented by  $\mu_4$ ,
  - When  $0 < \mu \leq 4$ , named "worse", and represented by  $\mu_5$ ,
- Single factor evaluation

With "human resources" as an example, according to the survey, separate from the human resources of the primary index of each factor, the Beijing office online system digital

certificate resource sharing ability is evaluated statistically, and the single factor evaluation sets are given respectively,

$$R_{11} = [0.35 \quad 0.15 \quad 0.2 \quad 0.2 \quad 0.1] \quad (2)$$

$$R_{12} = [0.5 \quad 0.1 \quad 0.2 \quad 0.1 \quad 0.1] \quad (3)$$

$$R_{13} = [0.4 \quad 0.2 \quad 0.3 \quad 0 \quad 0.1] \quad (4)$$

$$R_{14} = [0.4 \quad 0.15 \quad 0.2 \quad 0.15 \quad 0.1] \quad (5)$$

$$R_{15} = [0.45 \quad 0.2 \quad 0.15 \quad 0.05 \quad 0.15] \quad (6)$$

Therefore, the advancement evaluation matrix is:

$$R_4 = \begin{bmatrix} 0.35 & 0.15 & 0.2 & 0.2 & 0.1 \\ 0.5 & 0.1 & 0.2 & 0.1 & 0.1 \\ 0.4 & 0.2 & 0.3 & 0 & 0.1 \\ 0.4 & 0.15 & 0.2 & 0.15 & 0.1 \\ 0.45 & 0.2 & 0.15 & 0.05 & 0.15 \end{bmatrix} \quad (7)$$

Using the fuzzy AHP model calculation:

$$B_4 = W_4^T \circ R_4 = [0.394 \quad 0.124 \quad 0.124 \quad 0.234 \quad 0.124] \circ \begin{bmatrix} 0.35 & 0.15 & 0.2 & 0.2 & 0.1 \\ 0.5 & 0.1 & 0.2 & 0.1 & 0.1 \\ 0.4 & 0.2 & 0.3 & 0 & 0.1 \\ 0.4 & 0.15 & 0.2 & 0.15 & 0.1 \\ 0.45 & 0.2 & 0.15 & 0.05 & 0.15 \end{bmatrix}$$

$$= [0.40 \quad 0.16 \quad 0.21 \quad 0.13 \quad 0.11]$$

According to the matrix R and indexes W of weight matrix, comprehensive evaluation results can be the finally given:

$$B = W^T \circ R = W^T \circ \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \\ B_5 \end{bmatrix}$$

$$= [0.3015 \quad 0.1732 \quad 0.1597 \quad 0.3015 \quad 0.0641] \circ \begin{bmatrix} 0.37 & 0.22 & 0.16 & 0.11 & 0.14 \\ 0.28 & 0.20 & 0.14 & 0.22 & 0.17 \\ 0.31 & 0.18 & 0.15 & 0.20 & 0.16 \\ 0.40 & 0.16 & 0.21 & 0.13 & 0.11 \\ 0.23 & 0.18 & 0.21 & 0.20 & 0.18 \end{bmatrix}$$

$$= [0.345 \quad 0.190 \quad 0.172 \quad 0.155 \quad 0.141] \quad (8)$$

#### 4. Result Analysis

By the calculation results can be seen that the evaluation results affiliated with outstanding, good, medium, bad, and worse membership degree are respectively 0.345, 0.190, 0.172, 0.155 and 0.141. The digital certificates of the Beijing municipal government resources

sharing service capability can be evaluated at outstanding level according to maximum membership degree principle.

#### 4. Conclusion

In this paper, the research target is digital certificates resource sharing service ability of government departments evaluation combined with literature query and questionnaire survey. Use relative entropy assembly methods of grey preference information decision, set up a digital certificate resource sharing service capability evaluation index system, and constructs the fuzzy AHP model to evaluate service capability. Finally, the general office of the Beijing municipal government is used on empirical analysis to conclude the result of digital certificate resource sharing service capability evaluation.

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