Information Service Quality Evaluation Study of Cloud Computing Environment Based on Big Data

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***Abstract*—Give full play to the big data in the cloud computing environment application advantages has become an important information service mode of the era of Internet +, paper with information service quality evaluation as the main line, using fuzzy comprehensive evaluation method to analyze a set of cloud computing environment information service quality evaluation process, at the same time, using the case of project construction example analysis, the evaluation of cloud computing environment based on large data information service quality has important reference value.**

Keywords-big data; cloud computing enfironment; information service; quality evaluation

I. INTRODUCTION

Internet + era, cloud computing environment is the basic information service environment, big data is a basic support, information environment play the service efficiency of the cloud computing environment based on large data elements numerous, complicated structure, close-knit and cloud computing environment of information service quality directly affect the big data application advantages into full play, to appraise the future scale of Internet + information environment. Cloud computing environment, therefore, to improve information service quality evaluation research based on large data cloud computing environment construction efficiency is of great significance [1].

II. CLOUD COMPUTING ENVIRONMENT INFORMATION SERVICE QUALITY EVALUATION PROCESS

Cloud computing environment based on large data information service quality can adopt the method of fuzzy comprehensive evaluation are analyzed [2]. The characteristics of large data of Internet + cloud computing environment, contains many elements, these elements jointly constructed for cloud computing environment based on large data. According to the building in front of the cloud computing environment information service quality evaluation index system, a two-level fuzzy comprehensive evaluation method can be used to build a cloud computing environment information service quality evaluation model, basic steps, as shown in Figure 1, including establishing evaluation index system of evaluation index set semantics, determine the evaluation set, determine the weight assembly of evaluation index, establishing the comprehensive fuzzy evaluation matrix and fuzzy comprehensive evaluation and assessment results etc.

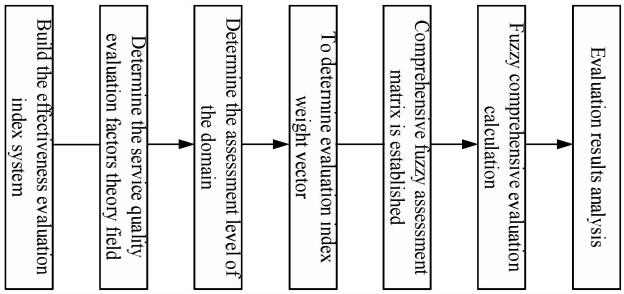

Figure 1. Two fuzzy comprehensive judgement procedure.

A. Build the Effectiveness Evaluation Index System

Cloud computing environment information service quality evaluation involves numerous elements, to consider the factors is more complex, because of the lack of cloud computing environment based on large data information service quality evaluation experience, therefore in constructing effectiveness evaluation index system, need to attach great importance to the collection of raw data, give full play to people's subjective initiative. Cloud computing application environment, which can be found that the core of the cloud computing environment based on large data elements including data transfer, data processing, information service, information security and information management of five elements. As a result, the data transfer capacity (U_1), data processing capacity (U_2), information service (U_3), information security ability (U_4) and data management capabilities (U_5) five level indicators based on big data to describe the construction efficiency of cloud computing environment is feasible. According to this method can generate secondary indicators of level indicator, etc, are no longer here.

Cloud computing environment information service quality evaluation index system, index dimensional units at various levels is not the same, in their evaluations are difficult to compare in the same category, which requires the index data are dimensionless processing [3]. Based on large data cloud computing environment information service elements is numerous, the relationship between the complex, difficult to accurate analysis of indicators. Therefore, in the relevant data of index system dimensionless processing,

index has the characteristics of typical interval is changed. This kind of index model interval index model can be used to describe, as follows:

$$b_{ij}=\begin{cases}1-\dfrac{\max(p_1^j-a_{ij},a_{ij}-p_2^j)}{\max(p_1^j-\min a_{ij},\max a_{ij}-p_2^j)} & a_{ij}\notin\left[p_1^j,p_2^j\right]\\ 1 & a_{ij}\in\left[p_1^j,p_2^j\right]\end{cases}$$
$$i\in N,j\in J$$

Among them, b_{ij} is the standard value, Max a_{ij} is biggest index, min a_{ij} is the minimum respect, I is the index level serial number, j is index number, j is category index data, [p_1^j p_2^j] is refers to the cloud computing environment information services index value range of high quality.

B. To Determine the Effectiveness Evaluation Factor Theory Field

Domain effectiveness evaluation factors theory, i. e. the cloud computing environment information service quality evaluation of the evaluation factor set, according to the previous description of cloud computing environment information service quality evaluation index system, it can be divided into two categories, indicators and secondary indicators sets [4]. According to the information and communication security five basic ability to determine the cloud computing environment information service quality evaluation indicators set U as follows:

$$U=\{U_1,U_2,U_3,U_4,U_5\}$$

Among them, the primary index U_i respectively data transfer, data processing, information service, information security and data management of five kinds of ability, ability of each corresponding secondary index sets:

$$U_i=\{U_{i1},U_{i2},\cdots,U_{in}\}$$

Among them, U_{in} is a basic ability of information and communication the corresponding influence factors.

C. Determine the Evaluation Theory Field

Evaluation theory field, it is in view of the cloud computing environment based on large data to evaluate a certain evaluation index parameters, their level of assessment results that may occur, usually by the expert qualitative or based on the technologies of cloud computing environment based on large data war given performance index parameter quantitative assessment, evaluation grade of domain is a collection of all evaluation of semantic level, can be expressed as follows:

$$V=\{V_1,V_2,\cdots,V_k\}$$

Among them, the k to assess levels of semantic sets.

D. Determine the Evaluation Index Weight Vector

Evaluation index weight vector, reflects the various evaluation index parameters in cloud computing environment in the process of the information service quality evaluation function of the proportion, its value is scientific will directly affect the information service quality evaluation of the results of the cloud computing environment.

E. To Establish a Comprehensive Fuzzy Evaluation Matrix

Because of the cloud computing environment most of the information service quality evaluation index parameter uncertainty index, is a fuzzy feature [5]. Therefore, we need to take the expert qualitative evaluation method to determine the parameters of evaluation indexes evaluation grade of membership degree of the domain, the specific method is: in the known evaluation level on the basis of the theory and the theory of evaluation grade domains, suppose there are m experts based on information service quality analysis, combined with their own work experience for each grade appraisal index parameter, give full play to the quantitative analysis and qualitative analysis combining the advantages of effectiveness evaluation. If the parameters U_i are scores of n experts evaluation is V_J , comprehensive fuzzy membership degree is as follows:

$$R_{ij}=n/m$$

Relationship between the set of all R_{ij} values is fuzzy comprehensive evaluation matrix R_i . According to the principle of fuzzy mapping, comprehensive fuzzy comprehensive judgment matrix can be deduced as follows:

$$R_i=\begin{bmatrix}r_{11} & r_{12} & \text{L} & r_{1k}\\ r_{21} & r_{22} & \text{L} & r_{2k}\\ \text{L} & \text{L} & \text{L} & \text{L}\\ r_{h1} & r_{h2} & \text{L} & r_{hk}\end{bmatrix}$$

F. Fuzzy Comprehensive Evaluation is Calculated

Fuzzy comprehensive evaluation calculation is essentially the result of fuzzy comprehensive evaluation parameters and weight coefficient, often should first implement the secondary fuzzy comprehensive evaluation, then level fuzzy comprehensive evaluation has been done, and according to the maximum membership degree principle to determine the assessment level.

- The secondary fuzzy comprehensive evaluation is calculated

Assumption of evaluation index weight parameters $A_i=\{a_{i1},a_{i2},\cdots,a_{ik}\}$, can get secondary index evaluation set for:

$$B_i=\{b_{i1},b_{i2},\cdots b_{il}\}=A_i\cdot R_i$$

- The level of fuzzy comprehensive evaluation is calculated

Calculated by the secondary fuzzy comprehensive evaluation index set U_i for the single index evaluation is B_i, can build a comprehensive fuzzy relationship matrix by fuzzy mapping as follows:

$$M = A \cdot B_i$$

If $U = \{U_1, U_2, \cdots, U_i\}$ index weight is $A = \{a_1, a_2, \mathrm{L}\, a_t\}$, can get:

$$M = A \cdot B_i = [a_1, a_2, \mathrm{L}\, a_i] \circ \begin{bmatrix} b_{11} & b_{12} & \mathrm{L} & b_{1l} \\ b_{21} & b_{22} & \mathrm{L} & b_{2l} \\ \mathrm{L} & \mathrm{L} & \mathrm{L} & \mathrm{L} \\ b_{i1} & b_{i2} & \mathrm{L} & b_{il} \end{bmatrix} = [m_1, m_2, \mathrm{L}\, m_l]$$

G. Evaluate the Results Analysis

In order to facilitate comparative analysis was carried out on the fuzzy comprehensive evaluation conclusion, need to assignment the evaluation theory of field, for quantitative comparison. Can, in accordance with the principle of maximum membership degree in the theory of evaluation grade domain selection information service quality evaluation conclusion is: the cloud computing environment.

$$M = \max\{m_1, m_2, \cdots m_l\}$$

III. Cloud Computing Environment Information Service Quality Evaluation Case Analysis

With some well-known enterprise electronic commerce platform construction, for example, in the process of construction, enterprise's chief information officer for three bidding scheme is analyzed, five level against the front macroscopic evaluation index analysis, put forward the 21 indicators closely related to the secondary microscopic evaluation index [6]. Restricted by space, here only to secondary index of primary index data transfer capacity (network coverage) as an example on the basis of the analysis of evaluation data. In order to improve the effectiveness evaluation is scientific, reduce man-made arbitrary, can use the ADC method using bidding scheme of hard targets information service quality evaluation, it is concluded that the secondary index ability efficiency value, as the basis of cloud computing environment information service quality evaluation data.

A. Cloud Computing Environment Information Service Quality Evaluation Index Analysis

To plan a network coverage performance analysis, for example, a reference scheme is given to illustrate the application of cloud computing services environment index, the probability of its online and stable operation is 95%, the probability of failure is 5%; Appeared severe attacks, e-commerce cloud services platform paralysis probability of 40%, an hour to repair probability of 90%, annual cloud services platform crisis running time is 30 days; In view of the network coverage, availability, the cloud service platform will be guaranteed, under the condition of complete ability index of the probability is 100%; Usability guaranteed the cloud services platform, when there is no guarantee can be dependent, the probability of operating task is 75%; Availability without guarantee, the cloud service platform will be guaranteed, the probability of operating task is 45%; Availability and the cloud services platform dependencies are the absence of security, the probability of operating task to 0.

According to the case for data, the basis of reference information service quality analysis model can obtain the following parameters: $a_1 = 0.95$, $a_2 = 0.05$, $m = 0.4$, $n = 0.9$, $c_{11} = 1$, $c_{12} = 0.75$, $c_{21} = 0.45$, $c_{22} = 0$, $t = 30$.

Can get to the dependency matrix by calculation parameters:

$$d_{11} = \frac{n}{m+n} + \frac{m}{m+n} e^{-(m+n)t} = 0.302$$

$$d_{12} = \frac{m}{m+n}[1 - e^{-(m+n)t}] = 0.698$$

$$d_{21} = \frac{n}{m+n}[1 - e^{-(m+n)t}] = 0.294$$

$$d_{22} = \frac{m}{m+n} + \frac{n}{m+n} e^{-(m+n)t} = 0.706$$

The efficiency of network coverage calculation is as follows:

$$e_{11} = A \cdot D \cdot C = \sum_{i=1}^{2} \sum_{1=1}^{2} a_i d_{ij} c_{ij} = 0.791$$

For the same reason you can get the following information service quality basic data collection:

$$E = \{E_1, E_2, E_3, E_4, E_5\}$$

Among them, the child set for E could be described as follow:

$$E_1 = \{e_{11}, e_{12}, e_{13}, e_{14}, e_{15}\} = \{0.791, 0.825, 0.768, 0.626, 0.919\}$$

$$E_2 = \{e_{21}, e_{22}, e_{23}, e_{24}\} = \{0.803, 0.927, 0.866, 0.715\}$$

$$E_3 = \{e_{31}, e_{32}, e_{33}, e_{34}\} = \{0.985, 0.879, 0.752, 0.768\}$$

$$E_4 = \{e_{41}, e_{42}, e_{43}, e_{44}\} = \{0.625, 0.702, 0.782, 0.528\}$$

$$E_5 = \{e_{51}, e_{52}, e_{53}, e_{54}\} = \{0.925, 0.857, 0.909, 0.792\}$$

B. Cloud Computing Environment Information Service Quality Evaluation Calculation

Cloud computing environment information service quality evaluation in information service quality evaluation index system for the object, USES the front analysis information service quality indicators based on the numerical

data, adopt the method of fuzzy comprehensive evaluation to calculate.

- Determine the evaluation theory field

In order to distinguish between evaluation level, the evaluation results can be divided into five levels, namely:

$$V = \{V_1, V_2, V_3, V_4, V_5\}$$
$$= \{ best, better, general, worse, worst\}$$

- To establish fuzzy evaluation matrix

Using Delphi method, invited 10 people, information and communication domain experts based on cloud computing environment of large data information service quality indicators as the basis, combined with the expert experience, the cloud computing environment information service quality evaluation index scores [7]. In data transmission, for example, can be according to the plan to carry out the cloud computing environment based on large data of the construction of the evaluation results, can be based on the scheme based on large data of the construction of a cloud computing environment data transmission capacity evaluation results are shown in Table I.

TABLE I. CLOUD CALCULATION ENVIRONMENT CONSTRUCTION EVALUATION RESULT IN SCHEME ONE

Evaluation result / Second index	best	better	general	worse	worst
Network coverage	0.3	0.6	0.1	0	0
high-speed transmission	0.2	0.5	0.2	0.1	0
Neutral access	0.4	0.3	0.3	0	0
Dynamic network	0.2	0.3	0.4	0.1	0
Communication reliability	0.3	0.6	0.1	0	0

According to the table, can be based on the scheme based on large data of the construction of a cloud computing environment data transmission capacity evaluation matrix R_1^1 as follow:

$$R_1^1 = \begin{bmatrix} 0.3 & 0.6 & 0.1 & 0 & 0 \\ 0.2 & 0.5 & 0.2 & 0.1 & 0 \\ 0.4 & 0.3 & 0.3 & 0 & 0 \\ 0.2 & 0.3 & 0.3 & 0.1 & 0 \\ 0.3 & 0.6 & 0.6 & 0 & 0 \end{bmatrix}$$

Similarly, can be based on the program 2 and program of the construction of the three big data based cloud computing environment ability evaluation matrix R_1^2 and R_1^3 as follow:

$$R_1^2 = \begin{bmatrix} 0.4 & 0.5 & 0.1 & 0 & 0 \\ 0.3 & 0.4 & 0.2 & 0.1 & 0 \\ 0.4 & 0.4 & 0.2 & 0 & 0 \\ 0.3 & 0.4 & 0.1 & 0.1 & 0 \\ 0.5 & 0.3 & 0.2 & 0 & 0 \end{bmatrix}$$

$$R_1^3 = \begin{bmatrix} 0.5 & 0.3 & 0.1 & 0.1 & 0 \\ 0.4 & 0.5 & 0 & 0.1 & 0 \\ 0.3 & 0.6 & 0.1 & 0 & 0 \\ 0.4 & 0.4 & 0.1 & 0.1 & 0 \\ 0.6 & 0.2 & 0.2 & 0 & 0 \end{bmatrix}$$

By the same token, the gain can be calculated according to the three different schemes of the construction of the cloud computing environment based on large data processing ability, information service ability, information security and data management ability for the evaluation of matrix R_m^n, among them, $m = 2,3,4,5; n = 1,2,3$.

Restricted by space, No longer here.

- The construction of index weight set

Cloud computing environment index system of information service quality evaluation is divided into two levels, the level of the index system including data transfer, data processing, information service, information security and data management, and other five indicators weight, secondary index system in the primary index system on the basis of divided into five types of 21 index weight parameters. Based on the analysis of information entropy weight method, can effectively reduce the traditional fuzzy evaluation method in the consult experts to get the weight coefficient of subjective risk [8]. According to information entropy weight method, can calculate the scheme of a secondary index weight coefficient vector is respectively:

$$M_1^1 = [0.32 \quad 0.17 \quad 0.21 \quad 0.19 \quad 0.11]$$
$$M_2^1 = [0.35 \quad 0.21 \quad 0.26 \quad 0.18]$$
$$M_3^1 = [0.15 \quad 0.23 \quad 0.29 \quad 0.33]$$
$$M_4^1 = [0.32 \quad 0.28 \quad 0.19 \quad 0.21]$$
$$M_5^1 = [0.29 \quad 0.19 \quad 0.27 \quad 0.25]$$

By the same token, the plan 2 and 3 will be made available to the secondary index weight coefficient vector M_x^y and three schemes of primary index weight coefficient vector N_k^l, among them,

$$x = 1,2,3,4,5; y = 2,3; k = 1,2,3,4,5; l = 1,2,3 \ .$$

Restricted by space, No longer here.

- The fuzzy comprehensive evaluation is calculated

According to the previous description of cloud computing environment information service quality evaluation model to calculate, can get a data transmission scheme evaluation results as follows:

$$E_1^1 = M_1^1 \circ R_1^1$$

$$= [0.32 \quad 0.17 \quad 0.21 \quad 0.19 \quad 0.11] \circ \begin{bmatrix} 0.3 & 0.6 & 0.1 & 0 & 0 \\ 0.2 & 0.5 & 0.2 & 0.1 & 0 \\ 0.4 & 0.3 & 0.3 & 0 & 0 \\ 0.2 & 0.3 & 0.3 & 0.1 & 0 \\ 0.3 & 0.6 & 0.6 & 0 & 0 \end{bmatrix}$$

$$= [0.29 \quad 0.49 \quad 0.25 \quad 0.04 \quad 0]$$

Likewise be able to get other data transmission ability of the evaluation results, building common secondary fuzzy comprehensive evaluation the results of the collection E_k^l, among them, $k = 1,2,3,4,5; l = 1,2,3$.

A level set for the results of fuzzy comprehensive evaluation U_l, then $U_l = N_k^l \circ E_k^l$. Through calculation can plan, project 2 and 3 of vector for evaluation results as follows:

$$U_1 = [0.37 \quad 0.29 \quad 0.33 \quad 0.25 \quad 0]$$
$$U_2 = [0.36 \quad 0.43 \quad 0.31 \quad 0.21 \quad 0]$$
$$U_3 = [0.42 \quad 0.45 \quad 0.21 \quad 0.09 \quad 0]$$

The normalized processing can be:

$$U_1^{'} = [0.30 \quad 0.23 \quad 0.27 \quad 0.20 \quad 0]$$
$$U_2^{'} = [0.27 \quad 0.33 \quad 0.24 \quad 0.16 \quad 0]$$
$$U_3^{'} = [0.36 \quad 0.38 \quad 0.18 \quad 0.08 \quad 0]$$

C. *Cloud Computing Environment Information Service Quality Evaluation Results*

In order to evaluate the results are compared, and quantitative evaluation level of domain level indicators can be assigned values, assume

$$V = \{V_1, V_2, V_3, V_4, V_5\} = \{5,4,3,2,1\},$$

Then the schemes' comprehensive evaluation are:

$$Z_1 = U_1^{'} \cdot \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{bmatrix} = [0.30 \quad 0.23 \quad 0.27 \quad 0.20 \quad 0] \cdot \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{bmatrix} = 3.63$$

$$Z_2 = U_2^{'} \cdot \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{bmatrix} = [0.27 \quad 0.33 \quad 0.24 \quad 0.16 \quad 0] \cdot \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{bmatrix} = 3.71$$

$$Z_3 = U_3^{'} \cdot \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{bmatrix} = [0.36 \quad 0.38 \quad 0.18 \quad 0.08 \quad 0] \cdot \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{bmatrix} = 4.02$$

It can be seen by comparing the scheme 1 and scheme 2 is similar to the cloud computing environment of information service quality, plan three cloud computing environment of information service quality is higher, but not overwhelming. Plan, therefore, a better applicable to the current information environment, enterprises to adapt to the Internet + environment; Scheme 2 is suitable for the current information environment, enterprises are facing the information security threat; less Plan 3 based environment is generally applicable to information, need to fully reconstruct information environment, enterprises to deal with a variety of information security threats.

IV. CONCLUSION

Cloud computing environment based on big data is a typical information environment, the era of Internet + information service quality can directly affect the information cloud application advantages into full play, to transform traditional industries are information technology efficiency level gauge. In this paper, based on large of data cloud computing environment quality assessment methods of information service is just a preliminary research, in the process of specific industry application, also need further analysis index system, optimize the evaluation model, can match the actual application of the evaluation conclusion.

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