Enterprise Server Reliability Study based on the Analysis Method of Gray-level

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Abstract. How to judge the reliability of enterprise server has always troubled information managers and decision makers. This paper makes the reliability of enterprise server room as the research object, establish evaluation server index system reliability from four aspects of security, advanced technology, economy and production operation, evaluate and analyze it by multi-level gray analysis to provide basis for objective evaluation of room server status and updating decision-making.

Introduction

Enterprise room servers are many, which belongs to different information systems and the expensive purchase price is prevalent. The related degree between equipment is great and the logical structure is relative complex, of which part of or a large part of the equipment using time is over five years or 10 years. Enterprise application can not be interrupted, or even run maintaining a high intensity of 7X24. Whether the reliability of these long-run devices are stable or not, whether it is worth the update or not, which has become the problems placed in front of each information system management.

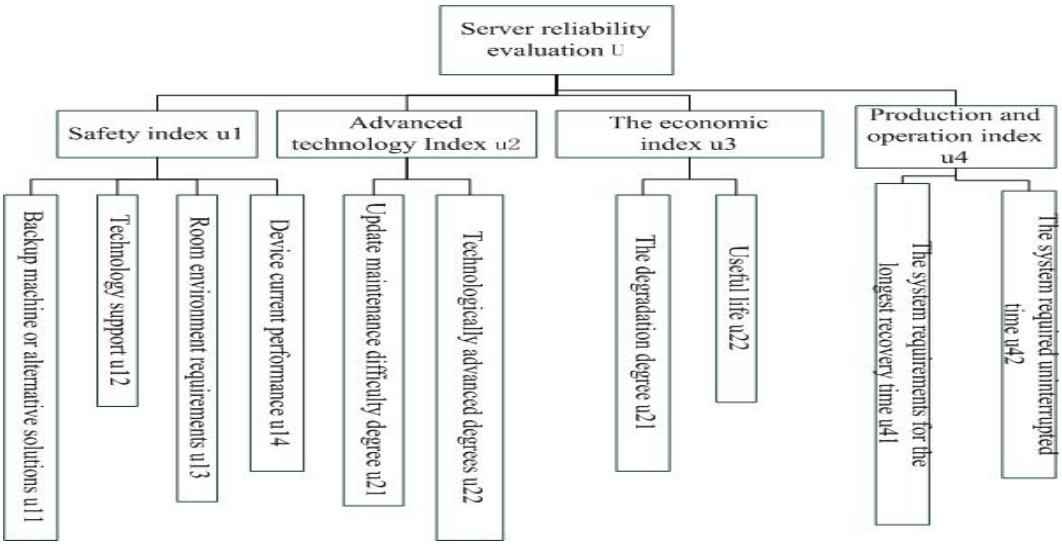
This paper scientifically evaluate the server having question in reliability, thus quantize the reliability metrics of server to digital and determine whether further updates or upgrades it in the form of high and low scores.

Reliability evaluation of server is a complex multi-factor system, and the index evaluating its level of reliability is multi-layered and complex. Currently, the evaluating methods are many, mainstream of which is AHP, whose essence is to compare and judge the importance between two factors. In general, this method is relatively easy to be implemented and objectively reflect the true relationship between any two; but in the face of some qualitative indicators or uncertain evaluation criteria indicators, the evaluation is often based on the knowledge level, cognitive ability and personal preference of evaluators and it is difficult to exclude bias of human factors and likely to cause not comprehensive and inaccurate information provided by the evaluator, namely the existence of gray, and so gray evaluation method was introduced to judge in the evaluation indicators, that is, evaluate the reliability of selected range servers using the gray level analysis method .

Build server reliability gray levels evaluation model and evaluation computing

Determine the index and establish evaluation hierarchy model

There are many indicators affecting server reliability (U), after the group discussions, identify four categories (Ui) and 10 evaluation indexes (Uij) and establish three levels index system:



Determine the evaluation grade and index weight by gray level analysis

Evaluation index u_{ij} is the qualitative indicators, the transformation into quantitative indicators can be achieved by making grade evaluation index standard. Divide the risk index of the evaluation u_{ij} into of the level of into high, higher, medium, lower, low reliability level 5, respectively were assigned the value 1, 2, 3, 4, 5, the index grade between two adjacent level and corresponding scores are 1.5, 2.5, 3.5, 4.5.

Determine the weight of each index by using the AHP method. The weight set of first level evaluation index u_i is $A=(A_1,A_2,A_3,A_4)$, and A ≥ 0, $\sum_{i=1}^{4} A_i$ =1

The weight set of second level evaluation index is $A_i=(A_{i1},A_{i2},\ldots\ldots A_{ij})$, $A_i \geq 0$, $\sum_{j=1}^{a_i} A_{ij}$ =1.

Organize and evaluate expert evaluation and determine the sample matrix and gray class

Suppose serial number of evaluation experts is k, $k=1,2,\cdots\cdots,k$,that is, there are k evaluation experts. Organize k evaluation experts treat server reliable performance and grade score according to the evaluation index standard and fill out the score table of evaluation experts.

According to the score table of evaluation experts, namely, according to Kth Article assessment expert's scores to one server reliable performance in accordance with the evaluation indexes u_{ij}, get the evaluation sample matrix D of the system:

$$D=\begin{bmatrix} d_{111} & d_{112} & \ldots\ldots & d_{11k} \\ d_{121} & d_{122} & \ldots\ldots & d_{12k} \\ & & \vdots & \\ d_{ij1} & d_{ij2} & \ldots\ldots & d_{ijk} \end{bmatrix} \begin{matrix} u_{11} \\ u_{12} \\ \vdots \\ u_{ij} \end{matrix}$$

To get the relative accurate and effective server reliability evaluation attribute, we need to determine the class number of gray type, gray number of gray type and the white weight function of gray assessment grades. Suppose evaluation gray type serial number, h, h =1, 2,..... , n, namely, there are n evaluation gray type. Take assessment gray clustering as five levels of excellent, good, medium, poorer, poor, namely n=5, and determine evaluation whitenization weight function of gray classes.

Calculate and get the comprehensive evaluation value

For the index U_{ij}, gray evaluation coefficient owning to the h evaluation gray type wrote as: $X_{i,h}=\sum_{k=1}^{p} f_h(d_i^k)$ （P means there are p experts ）

The general grey evaluation coefficient to each evaluation gray type wrote,

$$X_i = \sum_{k=1}^{N} x_{i,k}$$ （N means there are N experts）

For the index U_{ij}, gray evaluation weight of the h evaluation gray type wrote as $r_{ij,h} = \frac{X_{i,h}}{X_i}$

Calculate all the appraisal right and finally get the matrix R,

$$R = \begin{bmatrix} r_{11,1} & r_{11,2} & \cdots & r_{11,N} \\ r_{12,1} & r_{12,2} & & r_{12,N} \\ \vdots & & & \vdots \\ r_{ij,1} & r_{ij,2} & \cdots & r_{ij,N} \end{bmatrix}$$

Then, calculate the comprehensive evaluation value $B = A \times R = [b_1, b_2, \cdots b_N]$

Finally, calculate single worth and points were denoted as U. Supposed assign each gray grade cluster according to the gray level, then we can get the evaluation grade of gray cluster vectors $C = [100,80,\cdots 20]$, and finally calculate the comprehensive evaluation value U= $B \times C^T$,namely, single the value B, calculation and evaluation comprehensive evaluation of the value of the object B. The calculated results can compared it combining the comprehensive evaluation value of of each program and you can get the grade sequence of each enterprise server reliability.

The gray level analysis application examples of server reliability

After the server reliability index system is determined, expert group gets standard grade of specific evaluation indicators after discussion, listed in the following table:

Table 3.1: Grade standard table of evaluation index

The evaluation scores		5	4	3	2	1
Safety index u1	Backup machine u11	Hot preparation machine	The same type of cold preparation machine	same series of cold preparation machine	No backup machine, the alternative scheme	No backup machine alte-rnative sch-eme
	Technology Support u12	The original home and the third party support	The original home or third party support	The original phone support	No technical support, the relevant technical support can be find	No any technical support
	Room environment requirements u13	Superior environment	Great environment	Room load is relative nervous	Room load is nervous	Room load is very nervous
	The current performance of server u14	Hardware utilization rate is low	The occupancy rate of physical hardware is low	Hardware occupancy rate is higher	Hardware occupancy rate is higher	Overload hardware
Technology advanced u2	Update repair difficulty degree u21	Simple server maintenance	server maintenance is simple	server maintenance is complex	server maintenance is complex	server maintenance is extremely complex
	Technology progress u22	Frontier technology	The mainstream technology	The last generation technology	Technology will be eliminated	Fundamental changes in technology architecture
The economic index u3	The deterioration degree u31	The device is not failure	Maintenance costs account for less than 5% of the purchase cost	Maintenance costs account for 5%-10%	Maintenance costs account for 10%-30%	Maintenance costs account for more than 30%
	Fixed using time u32	1 to 3 years	3 to 5 years	5 to 7 years	7 to 10 years	More than 10 years
The production and business operation index u4	The longest recovery time of the system requirements u41	>48H	24-48H	8-24H	4-8H	<4H
	The no fault time of the system requirementsu42	>48H / Y	24-48H / Y	8-24H / Y	4-8H / Y	<4H / Y

Among selected important information system, 1 server 1#, the parameters is following, purchased in 2006, belongs to OA system and undertakes IIS function.

According to the above parameters, select 3 experts for evaluation group. Score the device 1-5 according to the standard, fill in the score table and get the evaluation value matrix:

$$D(K)=\begin{pmatrix} 4 & 4 & 4 \\ 3 & 2 & 2.5 \\ 4 & 2.5 & 4 \\ 3 & 3.5 & 3 \\ 1.5 & 1 & 1 \\ 2 & 3 & 3 \\ 4 & 3.5 & 4 \\ 3 & 3 & 3 \\ 3 & 2.5 & 2.5 \\ 3 & 3 & 3 \end{pmatrix} \begin{matrix} u11 \\ u12 \\ u13 \\ u14 \\ u21 \\ u22 \\ u31 \\ u32 \\ u41 \\ u42 \end{matrix}$$

Thus, get U1, U2, U3 and result in genus index for gray evaluation matrix R1, R2, R3 of each evaluation gray type.

Comprehensively evaluate the server U1, U2 and U3, the comprehensive evaluation results B1, B1=W1*R1=（0.2540，0.3176，0.3040，0.1244，0）.

Then,get B2，B3，B4.

Then,get B=W*R= $\begin{pmatrix} 0.2155 & 0.2694 & 0.3151 & 0.1790 & 0.0209 \end{pmatrix}$ .and the reliability integrated evaluation value of 1# U server is U=70.32.

According to all the score of 5, U at 1 respectively are 86.4, 43.8, we can set U>80 for-optimal, 72<U<80 is good, 60<U<70 is medium, 50<U<60 is relative bad, U<50 is bad.

Conclusion

This paper uses the gray hierarchy analytic process, build three levels of evaluation index system combining with the business information, describe information sufficient level by gray through the relationship between fuzzy relationship evaluation factor and reliability levels, on this basis, establish comprehensive evaluation model, whose evaluation is scientific and valid and the conclusions are maximize close to objective reality.

The reliability evaluation method established in this paper, the index system and assessment have reference in the reliability of enterprise information equipment and equipment upgrading judge.

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