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Risk Sorting for Enterprise under EC Environments

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ABSTRACT

With the rapid development of internet and emerging of global economic, risk management for enterprise under EC (Electronic Commerce) environments has drawn attentions of many researchers. In this paper, the characteristics of risk for EC enterprise are analyzed. Further, focused on the project organization mode and the uncertain factor of the enterprise under EC, which are main different characteristics from the conventional enterprise, enterprise risk sorting, which is one of the key problems of risk management under EC environments, is studied by using fuzzy ISODATA cluster method based on fuzzy describing of risks. Case study suggests the effectiveness of the method.

Keywords: electronic commerce, risk management, risk sorting, fuzzy cluster

1. INTRODUCTION

As the developing of computer and communication technology and the forming of global market economy, internet-oriented EC (electronic commerce) has become a trend and a must for enterprise operation [1,2], which made enterprise management under EC environments a popular issue among the field of management [3-6]. Since there are more uncertainties and unstable factors in enterprise operation under EC environments, such as the dynamic nature of enterprise alliance in different districts, regions even nations, and the leading function of enterprise development caused by new technology progress, enterprises are facing a larger number of conspicuous risks and enterprise risk management, as a special kind of enterprise management, is becoming more significant.

Risk sorting, one of the fundamental works of risk management, aims at acquiring overall and profound knowledge of all kinds of risks after sorting the existed risks from different point of view and according to different criteria and therefore suggests a well-aimed management. Many researches has done about risk sorting [7], however, most of them are qualitative method [8,9], and the features of enterprise under EC are not considered. In this paper, we focus on the project organization mode and the uncertain factor of the enterprise under EC, which are main difference from the conventional enterprise. In the research risks are sorted by the sub-procedures of enterprise projects under EC environments. With the focus on the uncertain features of enterprise risks under EC environments, a fuzzy risk description mechanism is established and a fuzzy sorting is given to the risks by fuzzy ISODATA [10,11] cluster method, which providing a satisfactory preparation for risk evaluation and control.

2. FUZZY RISK DESCRIPTION MECHANISM

The risks to be sorted are denoted by set $A=\{A_1,A_2,...,A_n\}$, factor set to be considered by $B=\{B_1,B_2,...,B_m\}$. n represents the number of risks, m represents the number of evaluation factors , hence the descriptive vector of each risk A_i is :

$$X_i=\langle x_{i1},x_{i2},...,x_{im}\rangle \qquad (1)$$

where, x_{ij} is the evaluation of i risk by j factor. Then, $X_{m\times n}=\{X_1,X_2,...,X_n\}$ is the factor evaluation matrix.

Let $C=\{C_1,C_2,...,C_c\}$ be the cluster set, which is sub-procedures of the enterprise project. c is the number of sorting, which is equal to the number of sub-procedures of the enterprise project. Let $V_{c\times m}$ be a group of cluster central vector, and then V_h be cluster center for sort h .

The aim of risk sorting is to get the sorting matrix $R_{c\times n}$ for common sorting and the fuzzy sorting matrix $\underset{\sim}{R}_{c\times n}$ for fuzzy sorting, where, $R\in M_c$

$$r_{hj}=\begin{cases}1 & i\in sort\ \ h\\ 0 & i\notin sort\ \ h\end{cases} \qquad (2)$$

And $\underset{\sim}{R}\in M_{fc}$, $M_{fc}=\{\underset{\sim}{R}\in V_{c\times n}\mid r_{hi}\in[0,1],\forall h,i$;

$$\sum_{h=1}^{c} r_{hi}=1,\ \ \forall i\ ;\sum_{i=1}^{n} r_{hi}>0\ ,\ \ \forall h\} \qquad (3)$$

3. FUZZY ISODATA CLUSTER ANALYSIS

Fuzzy ISODATA cluster is a fuzzy sorting method based on fuzzy descriptions [10,11].

The cluster criterion for common sorting aims at minimizing the object function:

$$J(R,V)=\sum_{i=1}^{n}\sum_{h=1}^{c}r_{hi}\left\|x_i-V_h\right\|^2 \quad (4)$$

where $\left\|x_i-V_h\right\|$ represents the distance between sample x_i and cluster central vector V_h.

The sorting is to minimizes the object function by determining an appropriate matrix $R_{c\times n}$ and $V_{c\times m}$.

The cluster criterion for fuzzy sorting aims at minimizing the object function:

$$J\left(\underset{\sim}{R},V\right)=\sum_{i=1}^{n}\sum_{h=1}^{c}\left(r_{hi}\right)^q\left\|x_i-V_h\right\|^2 \quad (5)$$

where q is a parameter equals or greater than 1. If $q=1$ and $r_{hi}\in\{0,1\}$, function (5) transforms to a common sorting.

This criterion minimizes the object function by determining an appropriate matrix $\underset{\sim}{R}_{c\times n}$ and $V_{c\times m}$ a group of cluster central vectors.

3.1 Fuzzy ISODATA Cluster Steps

1) Data normalization: using standardizing method

$$x'_{ik}=\frac{x_{ik}-\overline{x}_i}{\sigma_i} \quad (6)$$

In equation (6):

$$\overline{x}_i=\frac{1}{m}\sum_{k=1}^{m}x_{ik},\sigma_i=\sqrt{\frac{1}{m-1}\sum_{k=1}^{m}\left(x_{ik}-\overline{x}_i\right)^2} \quad (7)$$

2) Determine the number of cluster c, $2\le c\le n$, and an initial fuzzy sorting matrix $\underset{\sim}{R}^{(0)}\in M_{fc}$, let $l=0$, go to 3).

3) Calculate the cluster central vector for $\underset{\sim}{R}^{(l)}$:

$$V^{(l)}=\left(V_1^{(l)},V_2^{(l)},\cdots,Vc^{(l)}\right)^T \quad (8)$$

In equation (8):

$$V_h^{(l)}=\frac{\sum_{i=1}^{n}\left(r_{hi}^{(l)}\right)^q x_i}{\sum_{i=1}^{n}\left(r_{hi}^{(l)}\right)^q} \quad (9)$$

q is a positive number greater than 1. Go to 4).

4) Modify fuzzy sorting matrix $\underset{\sim}{R}^{(l)}$

$$r_{hi}^{(l+1)}=\frac{1}{\sum_{t=1}^{c}\left(\frac{\left\|x_i-V_h^{(l)}\right\|}{\left\|x_i-V_t^{(l)}\right\|}\right)^{\frac{2}{q-1}}},\quad (\forall h,\ \forall i) \quad (10)$$

Go to 5).

5) Compare $\underset{\sim}{R}^{(l)}$ and $\underset{\sim}{R}^{(l+1)}$, if for the given error accuracy $\varepsilon>0$ have:

$$max\left\{\left|r_{hi}^{(l+1)}-r_{hi}^{(l)}\right|\right\}\le\varepsilon \quad (11)$$

$\underset{\sim}{R}^{(l+1)}$ and $V^{(l)}$ are the results wanted. Stop iterating. Otherwise, $l=l+1$, back to 3).

3.2 Evaluation of Fuzzy ISODATA Cluster

Sorting Coefficient Index (SCI) can be applied to the evaluation the results of the fuzzy cluster:

$$F_c\left(\underset{\sim}{R}\right)=\frac{1}{n}\sum_{i=1}^{n}\sum_{h=1}^{c}r^2{}_{hi} \quad (12)$$

where $\underset{\sim}{R}\in M_c$, $F_c(\underset{\sim}{R})=1$.

Hence as $F_c\left(\underset{\sim}{R}\right)$ approaches 1, fuzziness of the ultimate sorting decreases, which indicates a better outcome.

4. CASE STUDY

4.1 Case Description

Let set A, which denotes the risks to be sorted, be:

A={demand risk, competition risk, overflow risk, market fluctuation risk, economic descent risk, financial risk, environmental risk, policy risk, quality risk, cost risk, time risk, technical risk, communicative risk, technical up-link risk, technical out-leak risk, data quality risk, information system security risk, organization and management risk, credit risk, mobility risk, excitation risk, strategic supple lost risk, investment hold-up risk, investment attainment risk}

It can be seen that $n=24$. Two situations are considered here, the number of sorting and factors for them are respectively:
$c_1=11,\ m_1=40$ and $c_2=17,\ m_2=45$.

4.2 Simulation Analysis

Two methods have been tried out here:

Method 1: Cluster on the basis of given initiative fuzzy sorting matrix $\underset{\sim}{R}^{(0)}$.

Method 2: Cluster on the basis of given fuzzy cluster central vector $V^{(0)}$.

Number of sorting c, the initiative fuzzy sorting matrix $\underset{\sim}{R}^{(0)}$, error accuracy ε and parameter q might affect the cluster results. So, the analyses of them are given in the following subsection.

(1) Influences of Different Methods on Cluster

Let error accuracy $\varepsilon = 0.00001$, parameter $q = 1.45$. The clusters of the two methods are compared in Table1.

As in Table 1, method 1 shows a superior outcome to method 2 because it takes relative constraints into consideration when choosing the initiative fuzzy sorting matrix.

Table 1 Comparison of the two methods

SCI / Method / No of sorting	Method 1	Method 2
$c_1 = 11$	0.601126	0.243985
$c_2 = 17$	0.780527	0.101113

(2) Influences of Different Initiative Fuzzy Sorting Matrix on Cluster

Figure 1 shows the graphs of the SCI against evaluation of initiative sorting matrix (error accuracy $\varepsilon = 0.00001$, parameter $q = 1.45$).

In Figure 1, initiative sorting matrix shows a very unstable influence on cluster outcome. Therefore, the actual risks and their characteristics should be given major consideration when determine the initial fuzzy sorting matrix.

(3) Influence of Different Error Accuracy on Cluster

Figure 2 shows the curves of cluster outcome against error accuracy ε (parameter q=1.45).

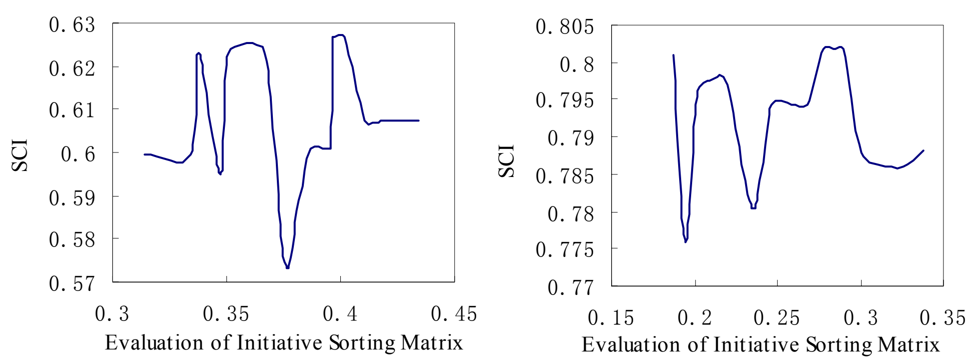
Figure 2 indicates that an error accuracy ε of 0.01 or less than 0.01 leads to a satisfactory outcome. This complies with that rule that cluster outcome improves as the error accuracy increases while deteriorates as it decreases.

(4) Influence of Different Parameter q on Cluster

The curves of cluster outcome against parameter q are represented by Figure 3.

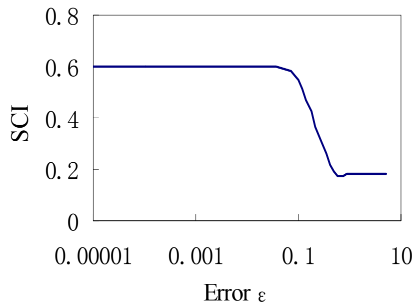
It can be concluded from Figure 3 that an increasing parameter q deteriorates the cluster. The fuzziness of sorting becomes smaller as parameter q gets closer to 1. When q equals 1 the sorting becomes a solid sorting. When q increases the sorting becomes fuzzier, which leads to a less definite implication. q=1.45 is chosen according to the actual situation.

The analysis above also indicates that the numbers of sorting does not show an obvious influence on cluster outcome. Nevertheless, more operational time of the procedure is needed as it increases: when c=11, the operational time is 3 seconds; when c=17, it is 4 seconds.

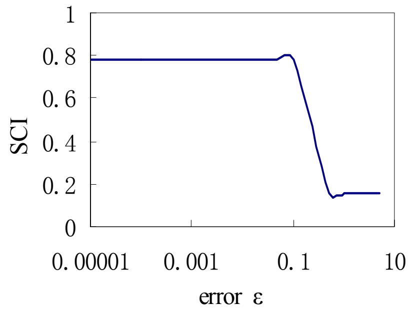


(a) c=11 (b) c=17

Figure 1 Curves of cluster outcome against initiative sorting matrix

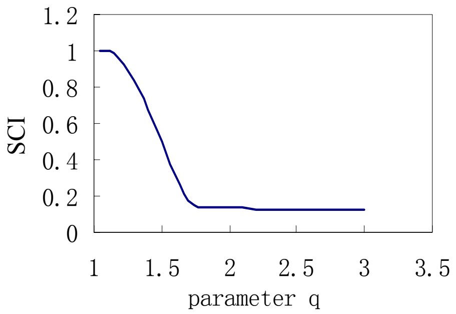


(a) c=11

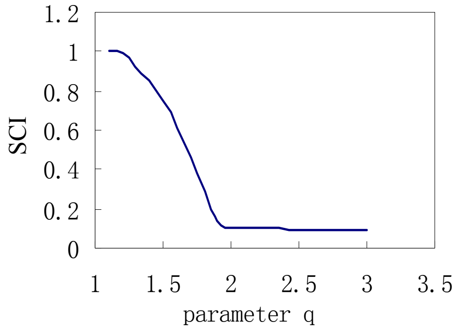


(b) c=17

Figure 2 Curves of cluster outcome against error accuracy



(a) c=11



(b) c=17

Figure 3 Curves of cluster outcome against parameter

(5) Sorting Outcomes

According to the analysis from (1) to (4), the ultimate sorting outcomes are listed in Table 2 when the number of sorting c =11, error accuracy ε = 0.00001, parameter q =1.45, evaluation of estimate of initiative sorting matrix is 0.386458.

It can also be seen in Table 2 that the sorting matrix meets the 3 requirements of fuzzy space division M_{fc} throughout the iteration because the sample initiative sorting matrix has been normalized. It shows:

$$r_{hi} \in [0,1], \quad \forall h,i \,; \quad \sum_{h=1}^{c} r_{hi} = 1, \quad \forall i \,; \quad \sum_{i=1}^{n} r_{hi} > 0, \quad \forall h$$

Hence the model is proved correct and the sorting result complies with objective facts as in Table 2.

5. CONCLUSION

In this research enterprise risk sorting – the key issue of enterprise risk management under EC environment – has been studied focus on the project organization mode and uncertain factors of the enterprise under EC. A fuzzy description system to enterprise risk is established firstly in accordance with the uncertain features of enterprise risk under EC environments then enterprises risk sorted based on the method of fuzzy ISODATA cluster considering the project sub-procedures is present. The case study involved has analyzed influences of parameters on cluster outcomes, which proves the effectiveness of the method and its significant guidance for enterprise risk management.

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Table 2 The sorting outcomes

c / n	1	2	3	4	5	6	7	8	9	10	11
1	0.00005	0.99955	0.00002	0.00002	0.00009	0.00004	0.00004	0.00004	0.00007	0.00004	0.00004
2	0.17134	0.21221	0.04138	0.03548	0.11356	0.06250	0.06167	0.05687	0.16065	0.05456	0.02978
3	0.92739	0.00700	0.00297	0.00523	0.01089	0.00827	0.01276	0.00425	0.01099	0.00737	0.00288
4	0.17986	0.07280	0.03363	0.04749	0.12518	0.14992	0.05799	0.07223	0.17191	0.06493	0.02406
5	0.05137	0.06989	0.01861	0.02341	0.37800	0.05206	0.03707	0.04958	0.12381	0.04930	0.14690
6	0.00000	0.00001	0.00000	0.00000	0.00001	0.00001	0.00000	0.00001	0.00001	0.00000	0.99995
7	0.00006	0.00002	0.00010	0.99940	0.00007	0.00008	0.00010	0.00005	0.00006	0.00004	0.00002
8	0.00000	0.00000	0.99999	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.05437	0.03192	0.03682	0.04486	0.13992	0.09657	0.09726	0.20909	0.16097	0.09186	0.03636
10	0.06524	0.03491	0.03010	0.04088	0.19246	0.06786	0.07249	0.10337	0.29883	0.06398	0.02988
11	0.00044	0.00020	0.00014	0.00034	0.00149	0.00130	0.00192	0.99207	0.00135	0.00054	0.00021
12	0.05138	0.01118	0.00669	0.02443	0.06815	0.08666	0.51411	0.13975	0.06400	0.02496	0.00869
13	0.01829	0.00520	0.00469	0.00828	0.02835	0.83461	0.03298	0.02023	0.01643	0.02739	0.00355
14	0.00484	0.00094	0.00080	0.00331	0.00385	0.00901	0.96009	0.01030	0.00339	0.00273	0.00074
15	0.00756	0.00112	0.00094	0.00460	0.00577	0.00744	0.95239	0.00782	0.00631	0.00517	0.00088
16	0.03325	0.01849	0.01734	0.04138	0.11116	0.22466	0.14304	0.09315	0.08211	0.22107	0.01435
17	0.04207	0.01412	0.02615	0.21130	0.10464	0.08048	0.15135	0.12206	0.10669	0.13044	0.01070
18	0.00049	0.00015	0.00013	0.00021	0.00154	0.00101	0.00047	0.00040	0.00084	0.99461	0.00015
19	0.03260	0.01277	0.01440	0.04253	0.16578	0.31176	0.07046	0.06851	0.19229	0.07535	0.01355
20	0.00882	0.00265	0.00360	0.00901	0.02095	0.88637	0.01677	0.01733	0.01607	0.01490	0.00353
21	0.00429	0.00187	0.00093	0.00160	0.93912	0.00605	0.00312	0.00542	0.02548	0.01083	0.00129
22	0.87663	0.00266	0.00277	0.00546	0.02311	0.01662	0.02030	0.01197	0.02759	0.01057	0.00232
23	0.00442	0.00127	0.00135	0.00132	0.02344	0.00356	0.00281	0.00461	0.95140	0.00400	0.00182
24	0.03006	0.00878	0.00927	0.01551	0.36882	0.18518	0.04435	0.08095	0.18081	0.05793	0.01834

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