

Fuzzy Comprehensive Evaluation of Enterprises Information Management Capabilities

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Abstract: Information management is an important part of enterprise management in the 21st century. On the basis of information management features, this paper constructs an index system for the evaluation of the information management capability. Analysis Hierarchy Process (AHP) is adopted to determine the weights of each evaluation index; the index membership degree is calculated according to membership function of Fuzzy Comprehensive Evaluation. The comprehensive evaluation of enterprises information management capabilities is obtained on the maximum membership degree principle. This paper aims to objectively reflect and effectively enhance the capabilities of enterprises information management and information innovation.

Keywords: Information Management; Capabilities evaluation; nalysis Hierarchy Process (AHP); Fuzzy Comprehensive Evaluation

1. Introduction

Driven by information technology revolution, Entrepreneurial economy and venture capital funds undergo rapid development, which led to the formation and development of Information Economy. Thus, information management emerges. Information management theory, techniques and methods is formulated, and soon causes a revolution in academic field of management.

Information management evaluation is an important part of information management. Quitas is one of the early scholars researching information management evaluation. The evaluation system includes the formulation, implementation of strategies for the development, acquisition and sharing of information, the measurement of operating performance of the enterprise that adopts information management and the analysis of the management activities that related to information ^[1]. Wiig and Cohen and others designed the evaluation system from the perspective of information discovery and using process, including information activity monitoring, the updates and the use information infrastructures, the formation of information assets, the learning of information and the allocation of information resources ^[2]. Andersen measures information management performance through the indexes from the sense of leadership, corporate culture, technology, evaluation, learning behavior change, and etc, thus provides a more comprehensive Information Management Assessment Tool (KMAT) for the managers adopting information management. As a result, the operability of information management evaluation is improved. On the basis of KMAT practice Skyrme D. Associates formulated the information management performance evaluation tool on the basis of information management strategy framework, which consist of information management capabilities, information management tools foundation for information management implementation. Bukowitz and Williams further studied information management evaluation practices and established Information Management Diagnostic. To reflect the relationship between tacit performance of information management and information management

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performance evaluation results and core competence of the enterprises, R. Kaplan and D. Nort made famous Information Management Performance Evaluation System based on Balanced Score Card (BSC).

Currently, evaluation of information management is breaking lose of school restrictions, developing toward to a comprehensive and intelligent evaluation direction. With the development of information management, the background of information management evaluation will be more microscopic and be tied more closely to objectives and specific industries. Developing a suitable information management evaluation system will become the key issue of information management.

2. Establish of Information Management Evaluation Index System

So far, a standard definition of information management has not been reached. Shu Huichuang defined information management as an enterprise's capability to create, organize, transfer and apply information resources, the capability demonstrated in the process of integrating information and other resources^[3]. Gold believes that information management capabilities consist of information-management infrastructure supporting capabilities and information management process capabilities. Information management infrastructure capabilities include three dimensions: technology, structure and culture; information management capabilities includes information acquisition, information conversion, and information application and information protection capabilities^[4]. Tanriverdi believes that an enterprise may have different information management capabilities in different fields therefore he divides information management capabilities into product information management capability, customer information management capability and information operation management capability, and in each field information management is subdivided into creativity, transfer capability, integrate capability and leverage capability^[5]. In this paper, on the basis of the above mentioned researches and according to the constitution of information management system, information management is defined as the information management process capabilities and infrastructure supporting capabilities from the following dimensions: information chain technology tools and environment support. Information management process capabilities include: information acquisition, information diffusion and information application capabilities. Infrastructure supporting capabilities include information and technology environment supporting capabilities and organizational environment supporting capabilities.

2.1. Supporting capabilities of information technology environment

Infrastructure mainly refers to IT platforms and office equipment. IT platform and information management process have a strong positive correlation, and the competitiveness of enterprises can be enhanced indirectly with the effective implementation of information management. Supporting capabilities of infrastructures is demonstrated by the ownership rate of infrastructures (computer, telephone ownership rate), utilization of network technology (network connection rates, the establishment level of portal, the usage MSN, e-mail, groupware systems, video conference, electronic forum usage), network performance levels, the establishment level of expert decision support system based on a database, information base, data warehouse, information warehouse, data mining technology and the coverage of information systems.

2.2. Supporting capabilities of information organizational environment

The establishment of flexible organizational structure is a premise and guarantee for an enterprise to achieve effective information management. Supporting capabilities of organizational structure is mainly reflected in the recognition degree of information management organizations (whether information structure is set, the position and rank CKO, the work of the highest rank of information management leader in an enterprise), the degree of flat organization structure, the establishment degree of team structure model.

2.3. Information acquisition capability

Information acquisition capability mainly refers to intelligent object retrieval, the capabilities to acquire information through multi-channel (collect information within the organization, exchange experience with customers, suppliers, industry partners, experts and learn from competitors), in multi-mode (data, text, graphics, images, spreadsheets, video etc.) and with multiple methods (interviews, Internet, telephone, etc.).

2.4. Information diffusion capabilities

Information diffusion means the sharing of information within an enterprise through the use of video conference, telephone conference, groupware, electronic forum, other information technology and training means.

2.5. Information application capabilities]

Information application means the process of employees' integration of newly absorbed information and existing information and applying it into the work process to solve the problem or make decisions, and its immediate purpose is business innovation. Information application capabilities is mainly reflected in the following aspects: the frequency of an enterprise's use of new information; employees' capability of acquiring information with various means to solve new problems and handle new tasks, employees' capability of using information to help develop new products and services; the effectiveness of the application of information improve the efficiency.

The information management capabilities evaluation index system that based on the connotations of information management capabilities is as follows.

TABLE. 1 EVALUATION INDEX SYSTEM OF ENTERPRISES INFORMATION MANAGEMENT CAPABILITY

	critierion layer	index layer
	Enterprises Information Management Capabilities (target layer)	Supporting capabilities of information technolog environment U_1
the construction level of expert decision support system (EDSS) U_{12}		
network utilization and network technology U_{13}		
the status of infrastructure construction U_{14}		
coverage rate of information system U_{15}		
Supporting capabilities of information organization environment U_2		technical condition of organizations U_{21}
		construction level of organizations U_{22}
		information sharing will of employee staff U_{23}
		system of rewards and penalties for information U_{24}
		the supporting degree of organization culture to information sharing and information innovation U_{25}
Capabilities in information acquisition U_3		enterprises information stocks U_{31}
		measure personal information stocks U_{32}
		external information internalization U_{33}
		ability of tacit information visualization U_{34}
Capabilities in Information Diffusion U_4		technical information diffusion U_{41}
	degree of information digitization U_{42}	
	expenses ratio for Educational training U_{43}	
	the status of communication within team members U_{44}	
	recognition degree of Information diffusion for senior levels U_{45}	

3. Evaluation Model for Information Management Capability

Fuzzy comprehensive evaluation is an important method in fuzzy mathematics, and can reflect the comprehensive level of an overall target in multi-layers, multi-quantity marks and multi-quality marks. In the evaluation model, the evaluation value of each factor can be determined by an appropriate method, therefore not only can the overall target can be evaluated comprehensively to have a macro view of the situation, each factor can also be evaluated to have a micro view of the situation. As a result fuzzy comprehensive evaluation can effectively address some of problems that can not be solved with the traditional evaluation methods or ordinary mathematical methods. There are some quantitative indexes in the above information management capability evaluation index system, so accurate data can be acquired. The rest are all qualitative indexes. In order to reduce the arbitrary judgments and improve the reliability of evaluation results, fuzzy comprehensive

evaluation that combines fuzzy mathematics and AHP is adopted in this paper in enterprise information management evaluation.

3.1. Determination of index weights

Index weights are allocated by AHP in this paper. This method emphasizes the role of the human thinking in the decision-making process which is standardized through a certain mode, so it is applicable to problems characterized by both qualitative and quantitative factors and can distinguish the degree of importance of various factors.

1) Construction of Matrix structure

Evaluation matrix is constructed through pairwise comparison of different indexes while using 1-9 ratio scale method. The evaluation matrix of criterion layer to target layer and index layer to criterion layer in is shown Table 2 and Table 3.

2) Single-level sorting

The priority weights of the element in this layer compared with the adjacent upper layer is calculated according to evaluation matrix, and some of the results is shown in Table 2 and Table 3.

3) Consistency Test

Upon examination, the consistency ratio of the weight vector in the above matrixes is less than 0.1 and meets the requirements of consistency.

3.2. Comprehensive Evaluation Method

Fuzzy comprehensive evaluation method is applicable to evaluate target systems that have many fuzzy criterions. This method is adopted to analyze the indexes membership degree to comment set.

TABLE.2 WEIGHT FACTOR DECISION TABLE

Serial numbers	Evaluation indexes	Evaluation indexes					Rating value
		B_1	B_2	B_3	.....	B_n	
1	B_1	*	k_{12}	k_{13}	.....	k_{1n}	p_1
2	B_2	k_{21}	*	k_{23}	.....	k_{2n}	p_2
3	B_3	k_{31}	k_{32}	*	.....	k_{3n}	p_3
.....
n	B_n	k_{n1}	k_{n2}	k_{n3}	k_{nm-1}	.....	p_n

TABLE.3 CALCULATION TABLE OF WEIGHTS

Serial numbers	Evaluation indexes	evaluators				Total valuation	weight
		1	2	...	m		
1	B_1	p_{11}	p_{21}	...	p_{m1}	$\sum_{i=1}^m p_{i1}$	a_1
2	B_2	p_{12}	p_{22}	...	p_{m2}	$\sum_{i=1}^m p_{i2}$	a_2
...
5	B_m	p_{1n}	p_{2n}	...	p_{mn}	$\sum_{i=1}^m p_{in}$	a_n
Sum		$\sum_{i=1}^n p_{1i}$	$\sum_{i=1}^n p_{2i}$	...	$\sum_{i=1}^n p_{mi}$	$\sum_{j=1}^n \sum_{i=1}^m p_{ij}$	1

1) Determination of comment set

Set $V = (v_1, v_2 \dots v_m)$ as comment set, m is the number of comments, in this paper, according to the features of comprehensive information management capabilities of an enterprise, set $m=5$, the comment set is $V = (v_1, v_2, v_3, v_4, v_5) = (\text{good, comparatively good, ordinary, comparatively bad, bad})$.

2) Calculation of weight

criterion layer set is $U = (U_1, U_2, \dots, U_s)$, s is the total number of criterions, $s=5$, the weight is $A = (a_1, a_2, \dots, a_s)$ index layer set is $U_i = (U_{i1}, U_{i2}, \dots, U_{ini})$, $i=1, 2, \dots, s$, U_{ini} refers to the index set corresponding with the i^{th} criterion in the criterion layer. The weight of index layer is $A_i = (a_{i1}, a_{i2}, \dots, a_{ini})$, n_i refers to the total number of indexes corresponding with the i^{th} criterion in the criterion layer. In this paper, the numbers is 4-5 respectively.

3) Single factor fuzzy evaluation

Single factor evaluation is applied to every n_i^{th} criterion of U_i . The matrix of the fuzzy evaluation of each index is

$$R_i = \begin{bmatrix} r_{i11} & \dots & r_{i1k} & \dots & r_{i1m} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ r_{ij1} & \dots & r_{ijk} & \dots & r_{ijm} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ r_{ini} & \dots & r_{inik} & \dots & r_{inim} \end{bmatrix}$$

$$i=1, 2, \dots, s$$

R_i is fuzzy evaluation matrix, shows a mapping from index set to comment set. r_{ijk} refers to the possibility of the k evaluation made by the j^{th} index in index layer to the i^{th} criterion in criterion layer.

Then the evaluation vector of the index set can be obtained which is $B_i = A_i \times R_i = (b_1, b_2 \dots b_{im})$, $i=1, 2, \dots, S$.

4) Comprehensive evaluation

In the whole evaluation index system, U is the criterion set in index set U_i , so the fuzzy evaluation matrix of U is

$$R = \begin{bmatrix} B_1 \\ B_2 \\ \vdots \\ B_s \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & \dots & b_{1m} \\ b_{21} & b_{22} & \dots & b_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ b_{s1} & b_{s2} & \dots & b_{sm} \end{bmatrix}$$

Finally, the evaluation vector criterion set of U_i is $B = A \times R = (b_1, b_2 \dots b_m)$, $b = \text{Max}(b_1, b_2 \dots b_m)$, and the fuzzy comprehensive evolution is v_k .

4. Conclusions

Information management is an important part of business management in present society, and information management evaluation is an exploration and a summary of the information management practice. The establishment multi-factored evaluation system is needed for the development of Information Management. Innovation of evaluation theory and technology and promotion evaluation results will be the focus of information management evaluation research. Based on the multi-dimensional, multi-level perspective of the connotation of information management capability, this paper has built a information management capability evaluation index system. The information management capabilities of an enterprise is evaluated and analyzed with the AHP and fuzzy evaluation theory, with the view to objectively evaluating and better reflecting the capability status of information management and the level of information innovation of an enterprise. At the same time, we wish this paper will provide new ideas and approaches to further improve the enterprise information management capabilities and information innovation level in the process of horizontal and vertical comparison and analysis of an enterprise, identify problems and draw experiences and lessons.

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6. References

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