



INFORMATIONIZED PERFORMANCE EVALUATION FOR MARINE ENGINEERING EQUIPMENT ENTERPRISES BASED ON KNOWLEDGE MANAGEMENT

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ABSTRACT

Informatization of marine engineering equipment enterprises, as a fundamental and important part of the national and social informatization construction, has become a strategic measure to improve the management level and to enhance the competence of the marine engineering equipment enterprises. The income and impact of information technology applications has been the focus of these enterprises. This article employs the method combining performance evaluation and informatization, and analyses from perspectives of knowledge management to help the marine engineering equipment enterprises maximize their enterprise value applying knowledge management. Through a combination of model analysis and practical research, it studies the principles, constructs the system and developed the method and model of informationized performance evaluation for marine engineering equipment enterprises based on knowledge management, and also conducts the empirical research. The research results can evaluate the informatization performance of marine engineering equipment enterprises and further offer the enterprises with necessary theoretical methods and tactical support to implement knowledge management effectively and to enhance their core competence.

Keywords: *Knowledge Management, Informatization, Performance Evaluation, Marine Engineering Equipment Enterprises, Fuzzy Comprehensive Evaluation Method*

1. INTRODUCTION

Knowledge has replaced the traditional factors of production, in twenty-first century, becoming the most important economic resource. Thus the enterprise knowledge mastering degree has a decisive effect on the enterprise survival and the development space. Harvard University scholars contend that twenty-first Century enterprise management has entered into the sixth stage, namely the globalization and knowledge stage, at which the sustainable development of enterprises has become the main goal of the management and the knowledge management has become the core of the management.

At present, as World's most potential industry, marine engineering equipment industry aims to implement enterprises value maximization. Therefore, the implementation of knowledge management is quite important, which has become a main approach to improve the core competence of enterprises. Marine engineering equipment enterprises' knowledge management implementation can promote the enterprise's core competence

and ability to resist risks[1-5]. The enterprises should also make full use of intellectual capital and integrate effectively a wide variety of internal and external resources in order to enhance their core competence and ensure the sustainable development. Nevertheless, the majority of our marine engineering equipment enterprises fail to understand the importance of knowledge management and lack appropriate knowledge management methods, resulting in low enterprise knowledge management level.

The performance evaluation plays an essential part in the process of knowledge management. The performance evaluation of the marine engineering equipment enterprise knowledge management can proceed by improving the theoretical basis of organization and management. Only with a whole set of appraisal theory as indicators, can the enterprises achieve a more accurate evaluation of knowledge management performance, and then improve the level of knowledge management, realizing the implementation of marine engineering equipment enterprise value maximization.



2. THE DESIGNING PRINCIPLES OF INFORMATIONIZED PERFORMANCE EVALUATION SYSTEM

Marine engineering equipment enterprise knowledge management performance is affected by many factors. Thus, various aspects are needed to be taken into consideration to get an objective evaluation index system. In order to improve the accuracy of evaluation, marine engineering equipment enterprise knowledge management performance evaluation index system should follow the following principles:

2.1 Applied Principle

The application of index system is needed when designing the evaluation index system, so as not to make ambiguity. The selected indicators should be easy for collecting information and data, and the data must be true. At the same time, each index should be quantified. Marine engineering equipment enterprise knowledge management performance evaluation index includes quantitative index and qualitative index. Quantitative index should be the main index, with the qualitative index as the reference in the meanwhile[6-12]. Then it will better reflect the marine equipment enterprise knowledge management performance.

2.2 System Principle

Systematicity should also be taken into consideration when designing the evaluation index system. The knowledge management of Marine engineering equipment enterprises is an integral system, of which all parts are mutual connected and influenced. So the evaluation index is able to accurately reflect each part of the enterprise knowledge management activities. Each link of the knowledge management performance can be reflected from the index system, which provides different dimensions to measure marine engineering equipment enterprise knowledge management performance.

2.3 Objective Principle

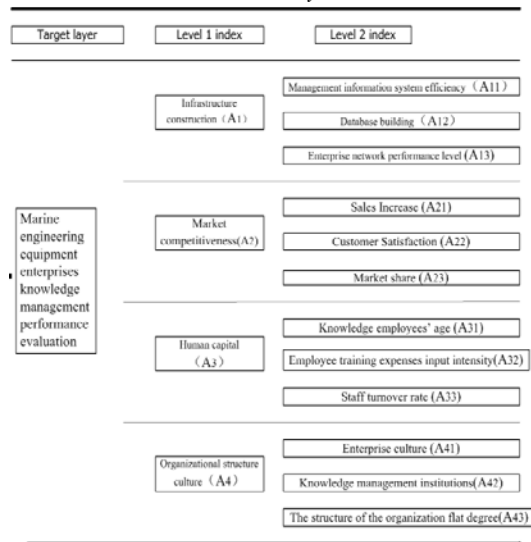
In addition, the objectivity of the index system should be given attention for the knowledge management performance evaluation system should be able to reflect objectively the achievement of enterprise knowledge management activities. To begin with, the definition should be accurately clear, without any ambiguity. Secondly, enough attention should be paid to quantify the standardization, so that different targets are comparable. Then it will help compare the

implementation of knowledge management performance of different enterprises, further improve the knowledge management.

3. THE CONSTRUCTION OF INFORMATIONIZED PERFORMANCE EVALUATION INDEX SYSTEM FOR MARINE EQUIPMENT ENGINEERING ENTERPRISES BASED ON KNOWLEDGE MANAGEMENT

Marine engineering equipment enterprises are knowledge and technology-intensive enterprises. Because the core knowledge and technology lies in the mind of intelligible workers, the evaluation should focus on the level of human capital. This article which is based on the characteristics of marine engineering equipment enterprises, combined with the principles set out by the evaluation, will consider and build knowledge management performance evaluation system of marine equipment enterprises from the four aspects as following: construction of infrastructure, market competitiveness, human capital, organizational structure and culture.

Table 1: Knowledge Management Performance Evaluation System



3.1 Infrastructure Construction

Infrastructure is the material basis for enterprise knowledge management, which includes three parts, management information systems application rates, database development, and enterprise network performance levels. "Management information system application rates" reflect the level of IT. "Database development indicators" reflect the collation and utilization of internal



documentation, including the rival databases and customer intelligence data. Among them, the level of customer database construction and use of performance is the key to knowledge management. "Enterprise network performance levels" also reflects the level of enterprise IT. Management information system applications and network technology is the foundation to improve the level of marine equipment enterprise knowledge management and very significant for the enterprise knowledge workers to acquire knowledge, apply knowledge and disseminate knowledge. If good applied, it can greatly enhance corporate value. "The enterprise network performance level" reflect the situation of internal computer network and software performance within the marine equipment, "Management information system application rate" indicators reflect the state of the infrastructure for marine equipment, management information system application rate = application MIS computer.

3.2 Market competitiveness

For marine engineering equipment enterprises, the market competitiveness is market potential for savvy asset which is owned by the enterprises and connected to the market. Improve the market competitiveness is the central gravity of enterprises. There are three measurable indicators: sales growth, customer satisfaction, market share. The evaluation of these three aspects can be a good grasp of the comprehensive status of the enterprise external information. The "sales growth" indicators reflect the situation of the specific sales growth in the industry; "customer satisfaction indicators" is to measure the satisfaction of the various services provided by the enterprises, which shows enterprise products and services quality and indicates competitiveness of the services and products. The improvement of the customer satisfaction is conducive to information exchange and knowledge sharing between marine equipment enterprises and customers; "market share" indicators are to measure market share within the same industry.

3.3 Human capital

Human capital is the most important resource when an enterprise implements knowledge management strategy. Marine equipment companies always rely on the quantity and quality of its knowledge staff to manifest its competitiveness. Huge profits could be reaped when key technical personnel and management staff who have professional knowledge are hired. Knowledge staff is a very important resource in marine equipment companies. When compared

with other companies in ship-building industry, marine equipment companies rely heavily on knowledge staff, because they play a significant role in elevating companies' competitiveness. Moreover, they are the main media of companies to acquire knowledge, put it into real practice and spread it to the public. "Service years" "Training expenses" and "Turnover rate of employee" are the indicators of human capital. "Service years" mean the total working years which indicates the overall technical ability and experience level of the professionals. "Training expenses" means the amount of expenses put into training the staff. This reflects that in order to improve the quantity and quality of its staff, whether marine equipment companies are willing to put costs or not; moreover, this can show the degree of the staff's importance. "Turnover rate of employee" means the ratio got by the left workers divide the hired ones. This number should be kept balanced, if it were lower than 5%, the companies' status of stableness but lack vitality could be shown; if it were higher than 20%, a part of the companies' management resources could have been lost.

3.4 Organizational structure and culture

Within the marine engineering equipment enterprises, it is very important to find the right organizational structure of knowledge sharing, innovation and organizational learning. It is also important to conduct the strategic management for respecting knowledge and emphasizing learning. Indicators of "corporate culture" reflect how much the values of the marine equipment enterprises influence the performance of knowledge management and the adaptability of entrepreneurial spirit to the external environment. Indicators of "knowledge management agency" reflect the perfection of administrations responsible for the knowledge management function and corporate governance mechanism for marine equipment. Indicators "flat organizational structure level" can effectively reflect the quality of exchange within the enterprises between the higher and lower members, thus explaining the organization and structure of the enterprise knowledge management, ensuring the effective communication of information, promoting the sharing of knowledge and helping enterprises to improve their own value.

4. METHOD AND MODEL OF INFORMATIONIZED PERFORMANCE EVALUATION

4.1 Evaluation Method

Using the fuzzy comprehensive evaluation method for Marine engineering equipment enterprise knowledge management performance to evaluate has certain rationality. The fuzzy comprehensive evaluation method based on fuzzy mathematics is one of the evaluation methods. This evaluation method through the membership application changes the qualitative evaluation into mathematics theory so that it can make quantitative evaluation for many factors of complex system and also can well solve the uncertain problems.

Offshore equipment enterprise knowledge management performance evaluation are affected by many uncertain factors, whose evaluation result is not absolutely sure or negative, that is very difficult to determine whether the enterprise knowledge management performance evaluation is good or bad, but it is expressed as a fuzzy set, which has some of the fuzziness, so the fuzzy comprehensive evaluation method can be applied to evaluate Marine engineering equipment enterprise knowledge management performance, that is, through the establishment of all indexes in index layer to evaluate the set of membership degree for comments. The main process includes determining the index evaluation sets, determining the index evaluation set, determining evaluation fuzzy matrix to make a fuzzy evaluation.

A. Determining the index evaluation sets A

$$A = (A_1, A_2, A_3, A_4)$$

$$A_1 = (A_{11}, A_{12}, A_{13})$$

$$A_2 = (A_{21}, A_{22}, A_{23})$$

$$A_3 = (A_{31}, A_{32}, A_{33})$$

$$A_4 = (A_{41}, A_{42}, A_{43})$$

B. Determining the index evaluation set V

Except evaluating comprehensively knowledge management level, we need to make sure all indexes comments sets. This article is on the basis of referring to the theories regarding the fuzzy comprehensive evaluation, and it chooses comments set $V = \{V_1, V_2, \dots, V_n\}$, this text only selects two evaluation results to establish evaluation sets: $V = \{V_1, V_2\}$. V_1 represents the high evaluation, V_2 represents the low evaluation. This paper sets each quantitative value of the

provisions in each element for V_1 (60, 100), V_2 (0-60), and in the final evaluation results, the value of V is between 100 and 0, that is the more close to 100, the enterprise knowledge management work equipment performance level is higher; the more close to 60, offshore equipment enterprise knowledge management performance level is lower. For the single factor evaluation of qualitative indexes, we can use the fuzzy statistics. Fuzzy statistics can make experts participating in the evaluation grade all indexes according to drawn evaluation standards. And experts can accord to the individual's professional experience combining with the actual situation of Marine engineering equipment enterprises, to evaluate various indexes affecting Marine engineering equipment enterprise knowledge management performance level. Set each expert $P_i (i = 1, 2, \dots, k)$ according to his point of view on all the evaluation factors $A_i (i = 1, 2, \dots, n)$ to judge, and the result is one of the comments set V , so as to determine the specific evaluation objects of fuzzy relation matrix R .

4.2. Model

Determining the weight coefficient of all the evaluation factors is the key to make reasonably offshore equipment enterprise knowledge management performance evaluation. It is important to final evaluation results, and determines scientifically and reasonably the weight of each index, and is an important link of practice and feasibility to ensure the index system in the actual evaluation work. Because the above index belongs to the most qualitative indexes, so we can use the Delphi method. According to the actual situation and experience of marine engineering equipment enterprise, scores are made by the experts, and we can determine judgment matrix, and get every weight coefficient of all indexes. Because the function and influence of all the evaluation index are different, so in the comprehensive evaluation, according to the weight of each indicator coefficient matrix of all indexes determined by experts $W = \{W_1, W_2, \dots, W_n\}$, we weight the combination of matrix W and fuzzy relation matrix R , that is, to evaluate comprehensively each evaluation objects, namely getting the fuzzy comprehensive evaluation model:



$$B = W \cdot R(W_1, W_2, \dots, W_n) \cdot \begin{bmatrix} r_{11} & r_{12} & \dots & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & \dots & r_{2m} \\ \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & \dots & \dots & r_{nm} \end{bmatrix}$$

$$\begin{aligned} w &= (0.2, 0.2, 0.4, 0.2) \\ w_1 &= (0.2, 0.4, 0.4) \\ w_2 &= (0.5, 0.2, 0.3) \\ w_3 &= (0.4, 0.2, 0.4) \\ w_4 &= (0.2, 0.4, 0.4) \end{aligned} ;$$

5. EMPIRICAL RESEARCH AND ANALYSIS

This empirical research has selected a maritime equipment enterprise A, situated at Haiyang City, Shangdong Province. The enterprise is a joint venture and has completed many projects as well as redeveloped projects. With a certain level of management, the maritime equipment enterprise has achieved some accomplishments in recent years by implementing knowledge management. Questionnaires which cover the condition of every dimension of maritime equipment enterprise's knowledge management have been designed in the research to collect relevant data. Meanwhile, five experts on the field of knowledge management have been invited to make evaluation by Delphi Method.

According to the data from the questionnaires of enterprise A, the five experts grade and evaluate them. As chart 2 shows, the grade has two ranks, which means, $V = (high, low)$, setting the membership degree of factors and establish the evaluation matrix.

Table 2: Data Sample

Target layer	Level 1 index	weight	Level 2 index	weight	V1	V2
Marine engineering equipment enterprises knowledge management performance evaluation	Infrastructure construction (A1)	0.2	Management information system efficiency (A11)	0.2	0.7	0.2
			Database building (A12)	0.4	0.6	0.4
			Enterprise network performance level (A13)	0.4	0.6	0.4
	Market competitiveness (A2)	0.2	Sales increase (A21)	0.5	0.4	0.6
			Customer Satisfaction (A22)	0.2	0.7	0.3
			Market share (A23)	0.3	0.8	0.2
	Human capital (A3)	0.4	Knowledge employees' age (A31)	0.4	0.6	0.4
			Employee training expenses input intensity (A32)	0.2	0.5	0.5
			Staff turnover rate (A33)	0.4	0.8	0.2
	Organizational structure culture (A4)	0.2	Enterprise culture (A41)	0.2	0.7	0.3
			Knowledge management institutional (A42)	0.4	0.8	0.2
			The structure of the organization (at degree) (A43)	0.4	0.4	0.6

5.1 Weight

It can be known according to the data from Tab 2

5.2 Evaluation Matrix and Overall Evaluation

R_1, R_2, R_3, R_4 matrixes can be gotten based on the data from chart 2. Besides, according to the formula 1 and the above matrix, the result is:

$$\begin{aligned} B_1 &= W_1 \cdot R_1 = (0.6, 0.4) \\ B_2 &= W_2 \cdot R_2 = (0.7, 0.3) \\ B_3 &= W_3 \cdot R_3 = (0.6, 0.4) \\ B_4 &= W_4 \cdot R_4 = (0.5, 0.5) \end{aligned}$$

So have:

$$B = W \cdot R = (0.2, 0.2, 0.4, 0.2) \begin{bmatrix} 0.60.4 \\ 0.70.3 \\ 0.60.4 \\ 0.50.5 \end{bmatrix} \approx (0.6, 0.4)$$

If factors' quantization in every remark set is defined as $V1=100$, $V2=60$, then the final evaluation result of V is between 100 and 0. Moreover, the nearer the number is to 100, the higher the performance level of maritime equipment enterprise's knowledge management is. However, the nearer the number is to 60, the lower the performance level is. Then the rough evaluation result of performance level of knowledge management is:

$$B \cdot V = (0.6, 0.4) \cdot \begin{bmatrix} 100 \\ 60 \end{bmatrix} = 60 + 24 = 84$$

From the above evaluation results, we can draw the conclusion that the performance level of knowledge management of maritime equipment enterprise A is rather high. Furthermore, the results are in accord with realities of the enterprise. By means of systematism construction, the enterprise succeeds in widening the scope for improvement by accumulating and sharing knowledge among different departments. In addition, this case confirms the correctness of the index system of knowledge management performance evaluation.

6. CONCLUSION

According to the analysis above, we can safely reach the conclusion that in order to adjust to the development of information society, marine



engineering equipment enterprises should actively adopt advanced information technology and management system to improve their informationization level and provide enterprise knowledge management innovation service through the improvement of information system. In the meanwhile, along with the knowledge innovation enhancement, marine engineering equipment enterprises must make corresponding adjustment and innovation of their own organizational structure, so as to improve the enterprise knowledge management capability, and enhance the enterprises' performance.

ACKNOWLEDGEMENTS

This work was supported Project supported by the National Natural Science Foundation of China (Grant No. 71273072), and Project supported by the National Natural Science Foundation of Heilongjiang Province (Grant No. G201119), and Project supported by the Philosophy & Social Sciences Foundation of Heilongjiang Province (Grant No. 11B066)

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