Research on Evaluation Model of Organizational Knowledge Assets

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Abstract

Based on the introduction of the concept and evaluation models of knowledge asset, this paper proposes an Index System which comprises quantitative indices & qualitative indices and financial indices & non financial indices which are weighted by Analytical Hierarchy Process (AHP) method to evaluate organizational knowledge assets synthetically. The status of organizational knowledge assets management can be estimated by the final score calculated by Efficacy Coefficient method and Professional Evaluation method in this model.

Keywords: Knowledge Asset; Index System; Evaluation Model

1 Introduction

The generation and development of knowledge economy is affecting the structure of the world economy and social development. In the last 90s, Organization for Economic Cooperation and Development (OECD) (1996) firstly proposed the concept of "knowledge economy" in the World Development Report and indicated that knowledge is playing a very important role in the economic growth .

In an organization, especially in a knowledge-intensive organization (for example in a network corporation, software corporation, consultancy corporation and high-tech corporation, etc), knowledge asset is the key factor which influences the competitive capability of an enterprise(L.L.Zhang, Jun. Li and Yong Shi, 2005).

Accordingly, knowledge asset can bring benefit for organizations as same as the tangible asset and financial asset do. Thereby, successful organizations have to evaluate their knowledge asset rationally including measuring the extent of the development & employment of knowledge asset, beneficial status and its monetary value. At present, there are some systematic methods to evaluate organizational tangible asset, e.g. Replacement Cost Method, Market valuation Method and Expectation Income Method, etc. On the contrary, because organizational knowledge asset is intangible, potential, non-scarcity, hard to measure, and some other characteristics which make it distinct from tangible asset, it is very difficult to estimate knowledge asset(Baruch Lev, 2003).

Based on the spirit of Balance Scorecard (BSC) and some known evaluation model of knowledge asset, this paper claims an Index System to estimate it. In this system, every index is weighted by Analytical Hierarchy Process (AHP) method initially. Then, estimated score can be calculated by some qualitative and quantitative methods. Ultimately, management status of organizational knowledge asset and its monetary value could be integrated evaluated. In this case, this model may be widely applied.

2 Brief Review of Models to Evaluate Knowledge Assets

2.1 Definition of Knowledge Asset

Regarding knowledge asset, there isn't an accepted definition yet. Following the opinion of Robert Schindler, etc. (2003), this paper reckons that knowledge asset refers to the entire non physical assets. For instance, patent, copyright, brand, corporation image, employee skill, customer relationship, and public relationship, etc.

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Form 1 Brief description of knowledge asset evaluation models

Financial Model	**Brief Description**	**Characteristics**
Market value /book value Stewart(1997)	This model regards the difference between the market value and book value as the value of knowledge asset	1. Calculation is quite simple and money can be used to measure the value of knowledge asset. This could be applied in activities such as acquisition, merge, other asset business, and comparison of the diverse organizational knowledge asset in one industry, etc. 2. The credibility of only using financial index is not high. For instance, the market value of some companies can be fluctuating very sharply. Besides, from the aspect of asset management, there is not enough information about all the characteristics of knowledge asset. In this case, it is inconvenient to manage organizational knowledge asset.
Market Value /Replacement Cost Jame Tobin	This model defines the ratio of organizational market value and asset replacement cost as Q. when Q is more than 1 or/and other competitors, the organizational knowledge asset creates benefits.	
Countable Intangible Value Stewart(1997)	This model compares organizational asset beneficial rate with industrial average asset beneficial rate. To multiply the difference between the rates by organizational tangible asset value equals the benefits of knowledge asset. Then the result is divided by organizational average asset cost. The final number is the value of the organizational knowledge asset.	
Others		
Non-Financial Model	Brief Description	Characteristics
Skandia Navigator Skandia（1994）	This model is proposed by Skandia, who is a financial insurance company. It divides organizational knowledge asset into human capital, organizational asset, and customer asset. Besides, this model uses qualitative and quantitative index to evaluate knowledge asset.	1. It provides an integrated framework to evaluate organizational knowledge asset, supplies relatively sufficient information about the characteristics of all kinds of knowledge asset, and describes the causality between input and output. 2. It is inconvenient in business due to the non- monetary form of knowledge asset. The difference among all the methods makes it difficult for organizations to compare with each other. In addition, the importance of different knowledge assets to organizations is not presented.
Intangible Asset Monitor Sveiby(1997)	This model divides organizational knowledge asset into 3 categories: employees' ability (education, experience), interior structure (law pattern, management, system, culture, R & D, software), and exterior structure (brand, customer relationship, supply relationship). The index designed from these categories can be used to measure the efficiency of knowledge asset usage and its potential development	
Others		

2.2 Brief Introduction of Evaluation Models of knowledge assets

At present, some researchers and some relative research institutions have already developed several evaluation models which are presented in the above Form 1(Charles·Depton and Dennis·Shenile,2004. Kai Mertins, Peter He isig and Jens Vorbeck, 2004). As shown in Form 1, there are two kinds of models: Financial Models and Non-financial Models. The former one emphasizes particularly on evaluating the monetary value of organizational knowledge asset and the latter pays more attention to estimate the management status of organizational knowledge asset. Because knowledge asset is a new concept and its special characteristics comparing with tangible asset, these models are still have disadvantages and need to be improved. For example, as presented in Form 1, most non-financial models don't consider one factor. That is knowledge assets in different organizations have diverse importance. Thus it needs different evaluation weight. Similarly, in financial models, the way

of estimating the monetary value of knowledge asset is quite simple. In this way, it can't provide more detailed reference information to knowledge asset management.

3 Review of BSC Theory & AHP Method and the Establishment of Index System

3.1 Brief Introduction of Balance Scorecard (BSC)and AHP method

In the last 90s, Professor Robert S. in Harvard, proposed BSC method for organizational performance management. It evaluate organizational performance from finance, customer, internal business process, and learning & training aspects. BSC has been paid much attention to since it was developed. Due to the length of this paper, details of BSC could not be shown here.
Based on BSC method and some present evaluation models, this paper establishes an Index System to estimate organizational knowledge asset from finance, exterior structure, interior structure, and learning & development aspects. Detailed information is presented in the following Form 2.

Different knowledge asset makes diverse contribution to organizations and thus its importance is quite different. For example, in science & research organizations, the most important knowledge asset is human capital, therefore, learning & development aspect is more crucial to such organization. However, in logistic companies, the most important knowledge assets which is supply relationship, sub-distribution channel, etc. belongs to exterior index. In addition, the importance of knowledge asset is related to the phase of organizational development. For instance, if a company is in its mature phase, it may emphasize particularly on finance index (e.g. market value/book value). Thus, to evaluate knowledge asset, it is necessary to know the real circumstance and the importance of knowledge asset in the organization.

Form 2 Index and Weight Arrangement in evaluation model of knowledge asset

Aspect	Weight	Index	Weight	Sub-index	Weight
Finance	W1	Market value/book value	W11	Market Return Ratio	W111
				Net Asset Beneficial Rate	W112
		MarkeValue/Replacement Cost	W12	……	……
Exterior structure	W2	Brand	W21	……	……
		Customer relationship	W22	Understanding of Customers' characteristics	W221
				Customer Support and Service	W222
				Customer Maintaining	W223
		Supply relationship	W23	……	……
		Sub-distribution Channel	W24	……	……
		Other Relationship	W25	……	……
Interior Structure	W3	Patent、Copyright and Proprietary Technique	W31	……	……
		Label	W32	……	……
		R&D Ability	W33	Researcher/Staff	W331
				Research Expense/Sale Revenue	W332
		Business Flow	W34	……	……
		Management Ability	W35	……	……
		Information Network Communication System	W36	……	……
		Corporation Culture	W37	……	……
Learning and Develoment	W4	Experience & Skill	W41	……	……
		Learning & Training	W42	Training Times	W421
				Training Expense	W422
		Creativity	W43	……	……

Analytical Hierarchy Process (AHP) method was proposed by Saaty, an American Operational Researcher, in the last 70s. This method is a multi- criteria decision-making method which combines qualitative and quantitative methods. In this case, decision-makers could be able to

change their experimental judgment into numbers, so it is more practical when the criteria - structure is quite complicated and the essential data is short of(Qian Songdi, 1990). Due to the above advantages, AHP method is widely applied in the decision-making analysis area. As shown in Form 2, this paper adopts AHP method to estimate the index's weight in evaluating organizational knowledge asset.

3.2 Establishment of the Evaluation Model

3.2.1 Construction of the Index System

According to BSC method, this paper believes that the management status of organizational knowledge asset could be estimated from finance, exterior structure, interior structure, and learning & development aspects as shown in Form 2.

Finance index includes the ratio of market value and book value, the ratio of market value and replacement cost. In detail, there can be sub-indices which will not be stated here. The selection of financial index depends on the real situation of the organization and the way of getting the data. For example, regarding some companies which are listing in the stock exchange, it is very easy to know the ratio of market value and book value. However, in some companies which are not listing in the stock exchange or some non-profitable organizations, it is easy for them to get the replacement cost . Financial index is mainly used to evaluate the monetary value of organizational knowledge asset. It could be applied in acquisition, merge, and some other asset business, etc. Moreover, it also could be used in comparison of the different organizational knowledge asset in one industry.

According to the intangible asset monitor model proposed by Sveiby(1997), this paper would like to divide the organizational knowledge asset into exterior structure, interior structure, and learning & development. In addition, there can be sub-indices which are presented in Form 2. Exterior structure, interior structure, and learning & development indices could be used to evaluate the management status of organizational knowledge asset. These indices can supply quite elaborate characteristic information about knowledge asset as well. Furthermore, these indices are the incentives of acquiring knowledge asset benefit, namely, financial result. In this case, these indices can describe the relationship of input and output to some extent.

3.2.2 Calculation of the Weight of the Indices

As shown in Form 2, evaluation system of organizational knowledge asset is consisted of three levels : evaluation aspect, evaluation index, and sub-index. The way of weighting every index via AHP method is shown in the following description(Yong Shi, 2001):

(1) According to the specialty knowledge and experience, knowledge management professionals and the professionals in the estimated organization make the grading of indices in every level and there are two indices graded at each time. The grading is qualitative, then number the degree of the important according to qualitative description. For instance, regarding indices on the evaluation aspect, professionals might think financial aspect is a little important than exterior aspect, or relatively important, or very important, so number this grading as 2,3,4, respectively. Finally, we can calculate the weight value of each index by the AHP method.

(2) According to the professionals' grading result, the weight coefficient of every evaluation index can be calculated via AHP method. For example, the weight of the index on evaluation aspect is Wn(n=1-4, $\sum$Wn =1) ; the weight of evaluation index is Wnj(n=1-4, j=1-7, $\sum$Wnj =1);the weight of sub-index is Wnji(n=1-4, j=1-7, i=1-3,$\sum$Wnji =1), as shown in Form 2.

3.2.3 The way of Scoring in the Evaluation Model

As shown in Form 2, the indices in evaluation model of knowledge asset can be divided into quantitative and qualitative indices. Regarding the scoring of quantitative indices, the common ways are efficacy coefficient method, aggregate index method, etc. In this paper, efficacy coefficient method is chosen. Based on the principle of multi-objective plan, this method defines every evaluation index as Satisfactory Value and Non-permission Value separately. The Non-permission value can be the lower limit to calculate the degree of achieving satisfactory value for each index. Then the result can be transformed to be the corresponding evaluation score. At last, the integrated score can be educed via

weighted calculation. The scoring of the quantitative index is shown as follows：

Score = [（real value—non-permission value）/（satisfactory value-non-permission value）*40]+ 60

Integrated score of quantitative index= ∑score(each index)*weight coefficient

Regarding the qualitative index, usually the professionals could give score of the index directly. Similarly, the way of scoring the qualitative index is shown as follows:

Integrated score of qualitative index= ∑score(each index)*weight coefficient

Finally， sum up the integrated score of qualitative and quantitative indices can educe the final score of organizational knowledge asset. The range of the score in the model is 0-100. Thus, if an organization gets 100, it means that the score of each index in the evaluation model achieves satisfactory value.

The integrated score in the evaluation model shows the management status of the whole organizational knowledge asset. The score of each index presents the management status of knowledge asset in the corresponding category.

4 Case Study

This case study is carried out in a national-wide insurance consultancy company (which is named as company A in this paper). Company A mainly provides professional suggestion about insurance management, insurance arrangement, etc. to clients. It is the insurance consultant of many national famous insurance organizations and corporations. A is a typical knowledge-intensive corporation. It has no fixed assets such as machine and workshop, but only the knowledge and experience of employees which can provide intelligent service to clients. The top shareholder of A would like to transfer some shares in 2005. Because company A isn't a listed company, it couldn't price the stock via the capital market. Then according to the international convention, company A hired a world famous accounting consultant organization which is called company B to evaluate the stock and give the price. Company B uses Discounted Cash Flow (DCF) Model to figure out the price of theCompany A' stock. This price is 1.8 RMB/stock. However, the book value of the stock is 1 RMB. Based on the organizational knowledge management theories, the excessive price, 0.8 RMB should be the contribution of knowledge assets.

Form3 Score card of the knowledge assets in Company A

Aspect	Weight	Index	Weight	Score
Finance	W1 (0.58)	Market value/book value (real value: 1.8) (non-permission value: 1.2; Satisfactory value: 2)	W11(0.58)	90
Exterior Structure	W2 (0.22)	Brand	W21(0.48)	60
		Customer relationship	W22(0.25)	80
		Supply relationship	W23(0.15)	80
		Sub-distribution Channel	W24(0.07)	70
		Other Relationship	W25(0.05)	75
Interior Structure	W3 (0.14)	Patent、Copyright and Proprietary Technique	W31(0.18)	75
		Label	W32(0.2)	70
		R&D Ability	W33(0.12)	75
		Business Flow	W34(0.03)	65
		Management Ability	W35(0.22)	70
		Information Network Communication System	W36(0.1)	70
		Corporation Culture	W37(0.15)	75
Learning and Development	W4 (0.06)	Experience & Skill	W41(0.5)	80
		Learning & Training	W42(0.25)	65
		Creativity	W43(0.25)	80
Final score	80			

In order to let the purchaser of the stock know more about the company and evaluate the company's knowledge assets, company A decided to use the method which is presented in this paper to evaluate the knowledge assets. The steps are as follows:

(1)To make sure the type and the index of the knowledge assets by the experts of this industry, the senior management staff and the rich experienced employees according to the framework of Form 2. The result is illustrated in Form 3. Since the business revenue is not much, the number of employees is not big (business revenue is 30 million RMB/year and the number of employees is 100) and the types of business are relatively simple, there is no sub-index of the knowledge assets. That makes the evaluation process relatively easy.

(2)Let the persons who are mentioned in the above paragraph give the descriptive comparative evaluation of the index in every level. For instance, number the degree of the importance(such as index i is a little important than index j, or relatively important, or very important , or absolutely important) as 2,3,4,5,etc.

$$\begin{bmatrix} 1 & 3 & 4 & 5 & 6 \\ 1/3 & 1 & 2 & 5 & 5 \\ 1/4 & 1/2 & 1 & 3 & 4 \\ 1/5 & 1/5 & 1/3 & 1 & 2 \\ 1/6 & 1/5 & 1/4 & 1/2 & 1 \end{bmatrix}$$

Then use AHP method to calculate the weight. For example, for the 5 indices in the Exterior Structure, according to synthesizing the opinions of the evaluation personnel, the following matrix could be educed as above.

Afterwards, the weights of the above indices are 0.48,0.25,0.15,0.07,0.05. The weights of other indices could be figured out via the same method (see Form 3).

(3)The experts of the industry and the senior management staff define the satisfactory value and non-permission value of the quantitative indices, such as the way of calculating the score of the financial index in Form 3. The personnel may mark the score of the qualitative indices directly, such as the way of calculating the score of other indices in Form 3. At last the score of the knowledge assets in company A could be educed via integrating the score of the qualitative and quantitative indices.

Conclusively, the final score of the knowledge assets in company A is 80. That means the cultivation, usage and management of the knowledge assets is eligible and there is still a lot to be improved. Form 3 presents the management status of the knowledge assets in company A, the area which needs to be enhanced, and the improvement direction.

5 Conclusion

Keeping the present evaluation models of knowledge asset for reference and following the spirit of Balance Score card, this paper proposes an index system which combines financial & non-financial indices and quantitative & qualitative indices. In this way, the shortcomings of the past knowledge asset evaluation methods which emphasize particularly on financial aspect (or purely qualitative description) have been conquered to some extent. Weighting each index via AHP method can help to grade the importance degree of diverse knowledge assets in the organization. This might be the point which other models often ignore.

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References

[1]. OECD. 1996. The knowledge-based economy [R]. Paris.

[2]. LingLing Zhang,Jun Li and Yong Shi. 2005. Study on improving efficiency of Knowledge sharing in knowledge- intensive organization [C]. Proceedings of the 2005 WINE, HongKong.

[3]. Baruch Lev. 2003. Intangibles: management, measurement and reporting [M].China Labor Press .

[4]. Kai Mertins,Peter Heisig,Jens Vorbeck,. 2004. Principle of knowledge management and the best practice [M] Publishing Company of Qinghua University.

[5]. Sveiby.K.E.2002. Methods for measuring intangible asset[R]. Oct, 2002.

[6]. Robert S. Kaplan, David P. Norton. 2004.The balanced scorecard: strategy into action[M].Guang Dong Economy Publishing Company.

[7]. Qian Songdi. 1990.operational research [M].Beijing：Publishing Company of Qinghua University.

[8]. Yong Shi. 2001.Multiple criteria and muitiple constraint levels linear programming [M].Singapore:WorldScienti