

Study on Performance Evaluation of Innovative Enterprises Human Capital Management in Fujian Province of China Based on Evidence Reasoning*

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Abstract: Innovative enterprises construction is one of the main tasks that all levels of governments promote technological innovation projects in Fujian province as well as the important support and basis of constructing Fujian innovative province, but Human capital is the decisive factor for realizing innovative Enterprises construction. So, this paper presents the evaluation index system of innovative enterprises human capital management performance based on drawing lessons from the existing research results about performance evaluation of human capital management and combining the actual situation of innovative enterprises in Fujian Province, and then uses evidence reasoning(ER) to evaluate the 57 companies' human capital management performance of the first batch of innovative enterprises in Fujian Province.

Key words: Innovative enterprises in Fujian Province; Human capital management; Performance evaluation

1 Introduction

The Fifth Plenary Session of the party's sixteenth and National Science and Technology conference in January 2006 define enterprise as the main of innovation clearly and point out that this is the fundamental approach for China to improve the ability of independent innovation. It shows that innovation becomes the key to develop economy in the future of China. From the literature searching finds that the research about performance evaluation of innovative enterprise human capital management is not mature now, especially in the domestic, because of starting relatively late we have less the research performance evaluation of innovative enterprise human capital management, so this paper divides the literature into two parts which is innovative enterprise human capital and performance evaluation of enterprise human capital management, in order to draw lessons from the existing research results about innovative enterprise human capital incentive mechanism and performance evaluation of enterprise human capital management.

1.1 Literature of innovative enterprise human capital

Since Little A.D.^[1] came up with New Technology-based Firms, the human capital as an important factor has been led into the research about the growth and innovation of New Technology-based Firms by foreign scholars, such as Colombo^{[2][3]}(2005, 2009) and so on. From the foreign literature, though the entry point for scholars studying is different, for example, some of them is based on Competence-Based View, some is based on Dynamic Capability View or Resource-Based View and so on, over all, their main view about New Technology-based Firms human capital is that this kind of enterprise dependence on human capital is more powerful than the general enterprise, and the scarcity, inimitability and no reproducibility of human capital decides that human capital is certain to become the irreplaceable core competitiveness, especially, this kind of enterprise faces high Living environment risks, short technology update cycle and fast market responsiveness, which requires its the entrepreneur human capital has high quality and skilled human capital has high technological innovation capability, because it determines the capacity of enterprise development, so it is very important to enhance and improve the inventory, quality and structure of New Technology-based Firms human capital.

With leading into the concept of innovative enterprises, domestic scholars started to study on the connotation and characteristics of innovative enterprises. Especially, after coming up with the concept about building an innovative nation in our country, innovative enterprises have an unprecedented development, the study of scholars is continually deepening. In this background, the research of innovative enterprises human capital develops rapidly. Chen Chunhua^[4](2009) and so on present that

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innovative enterprises need the culture which encourages risk-taking and innovates, and use this kind of culture influencing and driving the sense of creation and innovation missions, in order to improve the enterprises' innovative capability and effectiveness. Yao Xin^[5](2009)and so on think that the particularity of innovative enterprises determines the importance of its managers and researchers, so it needs to motivate human capital by economic interests incentives, rights status incentives, property rights incentives, offering space for personal development and so on, in order to improve the innovation power of human capital. Xu Hong^[6](2008)and so on, they research the importance, characteristics, mechanism, current situation and development trend of innovative enterprises human capital, and then come up with some advice for innovative enterprises to improve its human capital contribution rate.

1.2 Literature of enterprise human capital management performance evaluation

when the foreign and domestic scholars research performance evaluation of human capital management, most of them draw lessons from the existing human resource management performance evaluation model, such as Grossmann V^[7](2008) and so on recur to input and output method which needs to compare with the investments which is human capital management departments costing for human capital(such as education and training input and so on) and the income which is human capital management departments attaining from the investment, and then evaluate the performance of human capital management departments. Lynn^[8](2009)and so on recur to BSC which needs to design indexes from financial level, customer level, operational level and strategic level, and then evaluate the performance of human capital management departments. Cui Hu^[9](2008) and so on recur to EVA to evaluate the performance of human capital management departments.

2 The Evaluation Index System and the Weight of Index

2.1 The evaluation index system

In the index system design process, it should follow the systematic principle, comparability principle, applicability principle and operational principle and it needs to combine with the independent index organically according to their intrinsic relation to form a comprehensive which can reflect the strengths and weaknesses of human capital management performance fully. According to the above principles and based on the existing literature and expert advice, this paper comes up with measuring innovative enterprise human capital management performance by innovation performance, human capital investment, human capital quality, human capital loyalty and human capital utilization efficiency from innovative human capital management its own characteristics. Its specific evaluation index system is in Table 1.

Table 1 The Evaluation Index System of Innovative Enterprise Human Capital Performance In Fujian Province

First	second	third
the evaluation index system of innovative enterprise human capital performance	innovation performance (0.153)	Proportion of the new product (service)'s sales income to the total sales income(0.363)
		Market share of the enterprise's new technique, new products, new technology (0.276)
		Rate of sales income growth(0.185)
		Rate of corporate debt rate(0.176)
	human capital investment (0.216)	Matching of human capital investment strategy and enterprise development strategy(0.201)
		Level of enterprise human capital investment(0.112)
		Level of enterprise employees' income(0.159)
		Condition of enterprise human capital incentive mechanism (0.165)
		Condition of enterprise employees' career planning(0.223)
	human capital quality(0.236)	Rate of enterprise human capital investment return(0.140)
		Proportion of R&D staffs to employees(0.540)
		Proportion of professional and technical staffs to employees (0.297)
	human capital loyalty(0.167)	Level of employees education(0.163)
		Employee satisfaction (0.401)
	human capital utilization efficiency (0.228)	Rate of core staff turnover(0.599)
		Number of enterprise's 1000 R&D staffs own granted patents (0.272)
		Number of enterprise's 1000 R&D staffs sponsor participate standard (0.170)
		Number of enterprise's 1000 R&D staffs own above the provincial level famous and well-known, famous trademarks(0.212)
		Condition of enterprise owns core technical innovation awards(0.158)
		Overall labor productivity(0.188)

Whereas consummating index system is a process of repeated practice tests and modifications, therefore this index system in the paper has the imperfection in its scientificness and operability, which needs to improve and perfect constantly in the practice.

2.2 AHP method determines the weights of indexes

According to the requirement of AHP method, it needs to design questionnaire, and then let experts (including university human resource management expert) judge the importance of all indexes in the evaluation index system of innovative enterprise human capital performance in Fujian Province. This paper totally designs and hands out 10 questionnaires and reclaims fully. And then calculates and tests according to the requirement of AHP method. If the consistency check of questionnaires is not satisfied, they will be fed back to experts, until the consistency check is satisfied. The results are in the table 1.

3 Empirical Analyses

3.1 Evidence Reasoning(ER) method

Evidence Reasoning is a kind of index synthesis, which are Yang et al. put forward based on the ideas of D-S evidence theory. This method is suit to solve some problems that are caused by insufficient or unclear awareness information. Now it is aroused great attention from domestic and foreign scholars, and it shows its advantage of solving uncertain decisions in the field of data fusion and expert system application^[10].

3.1.1 Problem description

Assuming alternative solution $a_i(i = 1, 2, \dots, m)$ has R basic indicators $C_1(a_i), C_2(a_i), \dots, C_R(a_i)$, the weight set of R indexes is $w = \{w_1, w_2, \dots, w_R\}$ (referring to table 1). $H = H_1, H_2, \dots, H_N$ expresses the collections framework including all levels that the indexes can be assessed. $\beta_{j,n}$ Expresses reliability that basic indicator $C_j(a_i)$ can be assessed to H_n level, it satisfies $\sum_{n=1}^N \beta_{j,n} \leq 1, \beta_{j,n} \geq 0, (j=1, 2, R)$. According to it, this paper assumes the basic indicator's evaluation grades $H = \{\text{Excellent, Good, General, Poor, Very poor}\}$.

3.1.2 Basic reliability

Defining $m_{j,n}$ is the degree that index $c_j(a_i)$ can make alternative solution a_i be evaluated H_n , this is basic reliability. $m_{j,H}$ the probability that eliminating $m_{j,n}$, it calls non-allocated reliability. They need to satisfy two conditions: $m_{j,n} = w_j * \beta_{j,n} \dots (1); m_{j,H} = 1 - w_j \sum_{n=1}^N \beta_{j,n} \dots (2)$, so $m_{j,H}$ can be changed $m_{j,H}$ can be changed $m_{j,H} = \bar{m}_{j,H} + \tilde{m}_{j,H}$, $\bar{m}_{j,H}$ is caused by weight, and $\tilde{m}_{j,H}$ is caused by the evaluation from evaluators is not complete. If evaluation is complete, $\bar{m}_{j,H} = 0$, its formula as follow:

$$\bar{m}_{j,H} = 1 - w_j; m_{j,H} = w_j(1 - \sum_{n=1}^N \beta_{j,n}) \tag{3}$$

3.1.3 ER algorithms

Assuming $C_j(C_j) = (C_1, C_2, \dots, C_j)$ as a subset of front j basic indicators (referring to table 1), so the formula of basic reliability standardization as follow:

$$\{H_n\}: m_{J(j+1),n} = K_{J(j+1)}(m_{J(j),n} * m_{j+1,n} + m_{J(j+1),n} * m_{j+1,H} + m_{J(j),H} * m_{j+1,n}) \tag{4}$$

$$\{H_n\}: m_{j,H} = \bar{m}_{j,H} + \tilde{m}_{j,H}, \bar{m}_{J(j+1),H} = K_{J(j+1)}[\bar{m}_{J(j),H} * \bar{m}_{j+1,H}] \tag{5}$$

$$\tilde{m}_{J(j+1),H} = K_{J(j+1)}[m_{J(j),H} * m_{j+1,H} + m_{J(j),H} * \bar{m}_{j+1,H} + \bar{m}_{J(j),H} * m_{j+1,H}] \tag{6}$$

$$K_{J(j+1)} = \left[1 - \sum_{t=1}^N \sum_{k=1}^N m_{J(j),t} * m_{j+1,k} \right] (j = 1, 2, \dots, R - 1) \tag{7}$$

So the synthesis reliability as follow: $\{H_n\}: \beta_n = \frac{m_{J(R),n}}{1 - \bar{m}_{J(R),H}} \tag{8}; \{H\}: \beta_H = \frac{m_{J(R),H}}{1 - \bar{m}_{J(R),H}} \tag{9}$

3.1.4 Utility function

Utility function is used to measure the preference relations of decision-makers, which tow conditions: $\beta_H = 0$ and $\beta_H \neq 0$. According to the result, the evaluation of alternative solutions in this paper is complete, that is $\beta_H = 0$ in this paper, so its utility function as follow:

$$u(a_i) = \sum_{n=1}^N u(H_n) * \beta_n(a_i) \tag{10}$$

3.1.5 Quartile ranking

According to the $u(a_i)$ of alternative solution a_i . If $\beta_H = 0$ and $u(a_{i+1}) > u(a_i) (i = 1, 2, \dots, m)$, it means alternative solution a_{i+1} is better than a_i , or it is contrary, so the greater the comprehensive expected utility alternative solution attains, the better it is.

3.2 Selecting evaluation object

After two-year tracking assessment to the first batch of innovative pilot enterprises in Fujian Province, the first batch of innovative enterprises engendered in September 2009, total 62 enterprises, which are the evaluation object of the paper. And the empirical data is from the information that innovative enterprises reported to Science and Technology Department of Fujian Province in 2010. Because there were only 57 enterprises reporting the information, so the paper's empirical data is from 57 enterprises. In order to better compare, 57 enterprises can be sorted to science-technology and electronic enterprises (22) and traditional manufacturing enterprises.

3.3 Analyzing evaluation results

According to the results of third grade indexes evaluation level and the ER algorithms, it can attain the quality ranking of 57 enterprises, it shows in the figures(the value above the column is the ranking and E stands for enterprise).

3.3.1 Analyzing the results of different types' enterprises

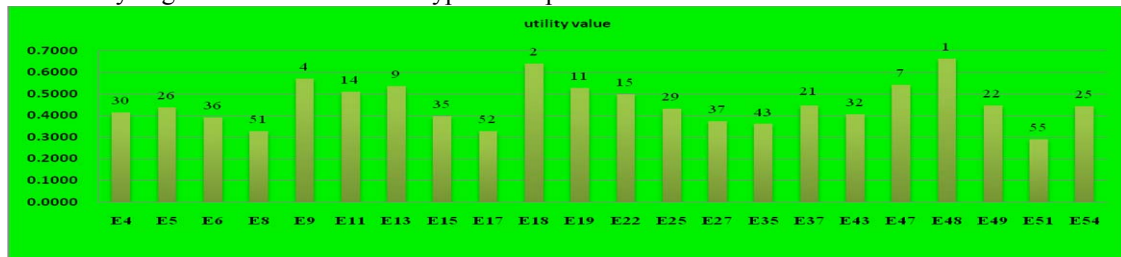


Figure 1 The Ranking of Science-Technology and Electronic Enterprises

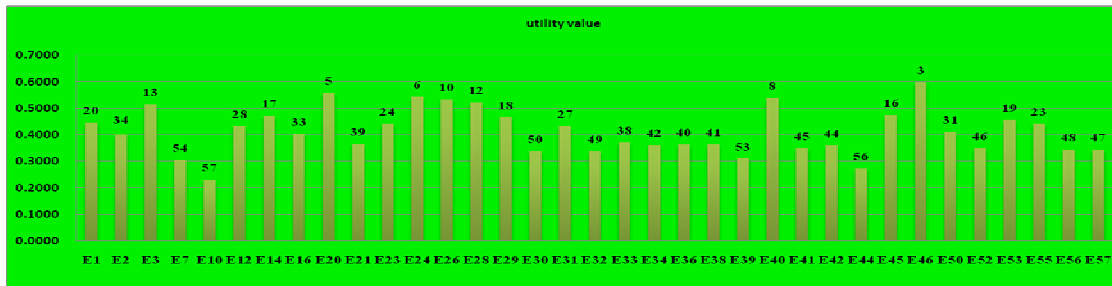


Figure 2 The Panking of Traditional Manufacturing Enterprises

From figure 1 and figure 2, it can get that the performance of science-technology and electronic enterprises is better than traditional manufacturing enterprises. Because the former needs the better human capital, so it pays more attentions to the human capital management, which makes it attain greater performance. From the top ten enterprises, it can get that the proportion of the top ten, 22 science-technology and electronic enterprises is 22.73%, but 35 traditional manufacturing enterprises is 14.29%. However, the difference between 22 science-technology and electronic enterprises is bigger, which shows that the space for its human capital management performance improving is more, and its own technology basis is strength. once this kind of enterprises invests more into human capital management, it will attain more benefit. In addition, traditional manufacturing enterprises face to the weakness of the transformation of economic development, industrial structure upgrade in this years, which makes them change their cost control to human capital to find new opportunities, the changing is clear in food processing and garment manufacturing. However, comparing to science-technology and electronic enterprises, the cycle of their human capital creating competitiveness is longer, which results in the slower development of their human capital management, they won't change the view of the manpower management is cost. So, resulting in the performance of traditional manufacturing enterprises

human capital management is weaker, which can attain from figure2.

3.3.2 Analyzing the results of 57 enterprises

Figure 3 shows that the top is E48, its total utility value is 0.6629. And E18 is the second, its total utility value is 0.6384, and then from third to tenth ranking are E46, E9, E20, E24, E47, E40, E13 and E26. On the other hand, according to the show of Science and Technology Department of Fujian Province's on Dispatching the notice about the list of the first batch of innovative enterprises in Fujian Province(Min Division[2009]38), the top ten enterprises in the evaluative results including E48, E46, E20 and E13 which have listed into National innovation pilot enterprises, it shows that the quality ranking of innovative enterprises human capital management performance in Fujian Province corresponds with the actual situation.

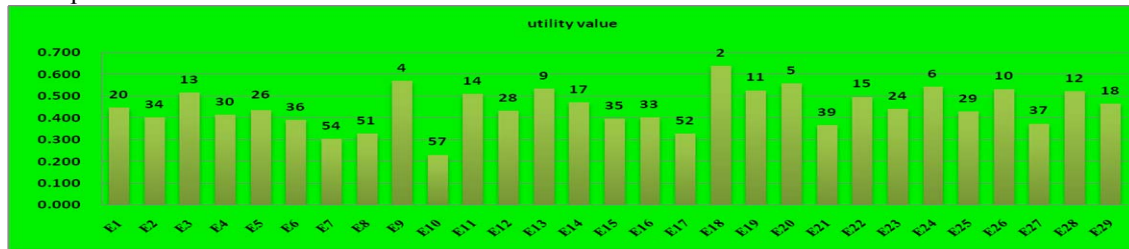


Figure 3 The Quality Ranking of 57 Innovative Enterprises Human Capital Management



Continuing figure 3

4 Conclusions

This paper uses Evidence Reasoning(ER) to evaluate 57 enterprises of the first batch of innovative enterprises in Fujian Province based on establishing the evaluation index system of innovative enterprises human capital management performance, and then attains the evaluative result that corresponds with the actual situation. In order to better compare, 57 enterprises can be sorted to science-technology and electronic enterprises (22) and traditional manufacturing enterprises, and then comparing and analyzing the difference between them. In view of the process of human capital management involving various factors, so evaluating the performance of it needs to think over all aspects, which can get the objective and overall evaluative results. Therefore, there are some problems in the process of evaluation in the paper, for example, comparison of different industries can be further broken down, which is to find some more pertinent question, and so on.

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