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Knowledge innovation performance evaluation in marine pharmaceutical enterprise in Zhejiang Province China

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ABSTRACT

On the basis of investigation and interview, so many affect factors were found out, and according to the research on innovation theory, the affect factors of technology innovation in Marine pharmaceutical enterprises in Zhejiang province were identified as human resources, Marine science and technology policy, financing environment, infrastructure, and Marine technology platform, Marine cultural environment, marketization degree, natural resources, etc. The relationship between the affect factors was clarified, and the impact on the Marine technology innovation was analyzed. a data envelopment analysis mode (DEA) was constructed to study the technology innovation performance evaluation. On the basis of the evaluation of Marine science and technology innovation ability of Zhejiang province, the feasible suggestions to promote its development were put forward.

Keywords: Marine pharmaceutical enterprise, innovation performance, Zhejiang Province, Data envelopment analysis mode (DEA)

INTRODUCTION

The 21st century is the century of ocean, the ocean has become the focus of the world competition. AS the 12th five-year plan of china carried the Marine economy to a strategic height, Marine industry has become the important fields in cultivating and developing strategic emerging industries. With the new situation of vigorously developing the Marine economy in China, the coastal area is in a new round of ocean development and regional economic development, Marine science and technology combined with economy increasingly closer. Zhejiang Marine economy demonstration area construction is in the exploration and the early stage, the government department focus on how to make a perfect Marine economy demonstration area. Evaluation of Zhejiang marine science and technology innovation ability is helpful for the government departments to fully grasp the present situation of the Marine science and technology innovation ability of Zhejiang province; And the suggestion on rising the ability of Marine science and technology innovation can be served as decision-making reference for government departments, to promote the construction of Zhejiang Marine economy demonstration area.

LITERATURE REVIEW

In 2000, scholars in Nanjing University built a set of index to evaluate regional innovation ability, and try to use the index system of innovation ability to make evaluation in 13 cities of Jiangsu province.[1] In early 2002, the experts carried on the comprehensive investigation and estimation on the innovative ability of cities in Guangdong province. The investigation included five aspects: innovation ability, knowledge innovation ability, enterprise technology innovation ability and technology innovation environment and the economic performance. The 113 indicators included r&d spending, intellectual property, the transformation of scientific and technological achievements, the enterprise innovation, the industrial structure optimization and the income. The innovation ability of cities in Guangdong province was comprehensive evaluated and ranked. In 2005, " the China enterprise independent

innovation ability analysis report" released by the national bureau of statistics, put forward evaluation index system of the independent innovation capability of an enterprise, from the Angle of technology innovation capability, including four indicators: potential resource index of technology innovation, technology innovation evaluation indexes, technological innovation output capacity, innovation environment indicators. L.H.,Zhao (2007) built technology innovation ability evaluation index system for the small and medium-sized enterprise, and built the secondary fuzzy comprehensive evaluation model according to the multi-attribute fuzzy decision-making method. [2] Z.Y., Wang(2011) evaluated Marine science and technology innovation ability and the Marine economic development in the coastal areas in China with analytic hierarchy process (AHP), and measured Marine science and technology innovation ability and the coordination degree of the Marine economy development with the coordination degree model.[3] Z.Y., Xie and H.P., Sun (2013)put forward an innovative model of marine S&T which may promote the cooperation of industry－university－research and upgrading the whole competitiveness of China marine S&T，and then analyzes its main operation links and key issues to solve.[4] The technical innovation ability is decomposed in Innovation resources into ability, ability of innovation management, research and development capabilities, manufacturing capacity and marketing capabilities. And technology innovation ability is the most realistic output index. On the basis of principal component analysis (PCA) and entropy evaluation method, the evaluation methods of technology and technological innovation ability were put out to measure 20 large and medium-sized enterprises in Fujian province empirical evaluation (C.G.,Zheng,2007).[5]

FACTOR ANALYSIS

To evaluate the technology innovation capability index selection is very important, different countries have their different indicators. In Italy, three indicators including the patent, technology trade, high-tech products import and export were used to measure its national innovation ability. Japan science and technology department measure the national technological evaluation with the index including the patent, technology trade, technology intensive products output, total value-added manufacturing. in order to highlight the important role of human resources, The EU member states evaluate the innovation ability of the EU member states, with the index system of innovation made up of the human resources, the creation of new knowledge, knowledge application and diffusion, innovation fund output and market.

Marine pharmaceutical enterprises innovation main body can illustrate from enterprise microscopic and national macroscopic. The affect factors of technology innovation in Marine pharmaceutical enterprises in Zhejiang province were identified as human resources, Marine science and technology policy, financing environment, infrastructure, and Marine technology platform, Marine cultural environment, marketization degree, natural resources, etc. Amply enterprises, from microscopic perspective a single enterprise innovation main body included technical workers - R&D personnel - sales – entrepreneurs. [6] Among them, the entrepreneurs are the core of enterprise knowledge supply chain subject, in the chain plays a leading role. Entrepreneurs through the regulation knowledge innovation resource allocation and use, can effectively coordinate and integrate other of the main body of the behavior innovation activities, in order to reduce the transaction cost. The other main body plays the role of participation, cooperation, makes specific innovation behavior. National macroscopic level of supply chain in knowledge innovation main body refers to analyze respective situation as a whole. [7] Therefore, put the whole chain in the national innovation system in macro level, and enterprise knowledge innovation embodies in the national science and technology resources allocation of various search of knowledge economization process, its final action goal is to improve national core competitiveness and international status.

The classification of knowledge innovation is regarded as the highest degree in style. It will look on a Marine pharmaceutical enterprise as a whole, the knowledge innovation take final role in three aspects: firstly, raise the level of technology, then improve the management ability of ascension and prompt the ascension of the sales ability. [8] That is to say, the Marine pharmaceutical enterprises' knowledge innovation can be summarized as three categories: final research and development capabilities, management innovation, marketing capabilities, such as figure 1.

MODEL ANALYSIS

A. Factors selection

This paper selects the factors which influence the knowledge innovation as the input variable[9], to evaluate the Marine pharmaceutical enterprises innovation ability. The final output result of the innovation ability is that increasing of industries rate embellish. But using the simply profit margin as evaluation index is not enough to explain relative income situation in industry scale. So we choose industry return on equity as final evaluation index.

As already mentioned, there are many influence factors of each enterprise innovation. And the final knowledge innovation of the enterprises is for the performance of the three forms: technical innovation, ability of innovation management and marketing capabilities[10]. Because of the interaction between the nodal enterprises difficult to get powerful data to explain, so we will complete the knowledge innovation performance evaluation, and select research

and development capabilities ability, ability of innovation management ability and marketing capabilities[11], the three indicators as input quantity.

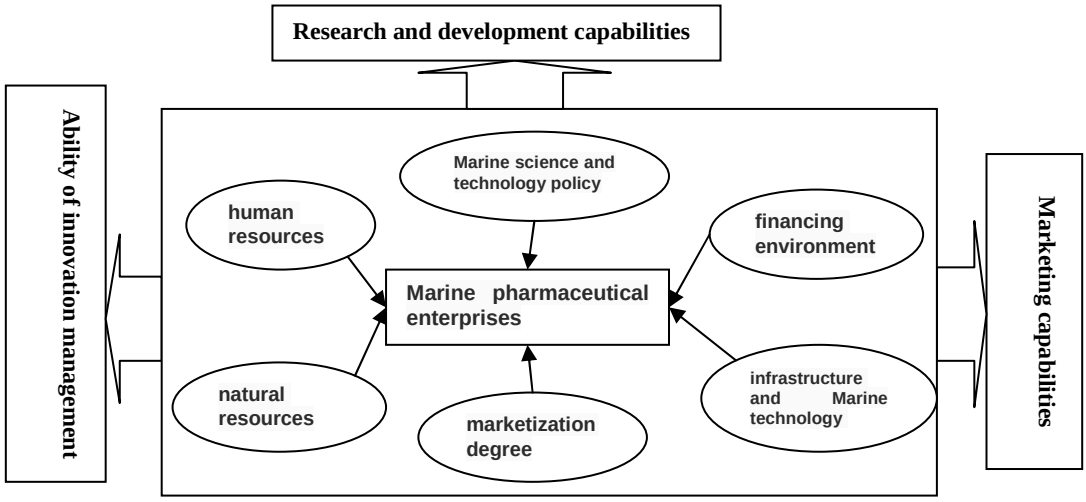

Figure 1 The Structure of Influence Factors

In this paper, the content is the evaluation for different period the Marin science and technology enterprises in Zhejiang Province of the longitudinal comparison, and selecting ability of management innovation, technology innovation, marketing capabilities as the input index, the return on equity as output index[12]. Based on the ach index score from statistical yearbook, we finally obtain input index system of each index, and construct the DEA model.

B. Evaluation Process

By the statistical yearbook, we select the data of computer industry in 2004-2012, which can reflect the relative ability of the technology innovation, marketing capabilities and ability of management innovation. Then, we carries on the data envelopment analysis (DEA)[13]. The input variables include management innovation input relative value (X1), technology innovation investment relative value (X2), market innovation investment relative value (X3), and output is return on equity (Y). Next, we make the list of sample data statistics, such as Table 1.

TABLE. 1 SAMPLE DATA STATISTICS

	Y	X_1	X_2	X_3
2004	0.0956	3.650	0.420	0.0752
2005	0.0978	3.782	0.446	0.0842
2006	0.1088	4.930	0.470	0.080
2007	0.0988	3.784	0.602	0.0804
2008	0.1142	4.504	0.462	0.0766
2009	0.1186	4.918	0.486	0.0830
2010	0.1142	4.556	0.456	0.080
2011	0.1182	5.292	0.462	0.0892
2012	0.1524	7.438	0.550	0.1174

We take the above data into linear planning model, and substitute DEAP software to carry on the calculation. Using the data in 2004 as the base for comparison, we can analysis computer manufacturing scale economic benefit situation in the existing each innovation factor weight.

DEAP software operates the results from the scale income situation, factor weight and expected input variables and output aspects in the data analysis. The scale profit condition list (Tab 2) shows the comprehensive results that, 2004, 2008, 2010 and 2012 years of knowledge innovation activities produced a relatively good economic benefit, and in 2005, 2007, 2009 years of knowledge innovation, there are some problems[14], and its effect for the performance of the scale diminish returns.

TABLE 2 OUTPUT DATA

firm	crste	Vrste	scale	
1	1.000	1.000	1.000	-
2	0.987	0.991	0.996	drs
3	0.923	0.945	0.967	irs
4	0.997	1.000	0.997	drs
5	1.000	1.000	1.000	-
6	0.971	0.985	0.986	drs
7	1.000	1.000	1.000	-
8	0.959	0.970	0.989	irs
9	1.000	1.000	1.000	-
mean	0.982	0.989	0.993	

In 2006 and 2011, the performance of knowledge innovation activity shows economic benefits increasing. At the same time, DEAP software have the data been adjusted. In the output invariable situation, it optimizes the input combination, and makes the scale economic benefit maximize, such as Tab 3, Tab 4.

TABLE 3 FACTOR WEIGHT

	X_1	X_2	X_3
1	1.000		
2	0.099	0.101	0.800
3	0.662	0.047	0.290
4	1.000		
5	1.000		
6	0.115	0.885	
7	1.000		
8	0.105	0.895	
9	1.000		

TABLE 4 EXPECTED INPUT AND OUTPUT

	X_1	X_2	X_3	y
1	3.650	0.420	0.076	0.096
2	3.750	0.442	0.076	0.098
3	4.258	0.448	0.076	0.108
4	3.784	0.602	0.080	0.098
5	4.504	0.4621	0.076	0.114
6	4.842	0.472	0.082	0.118
7	4.556	0.436	0.080	0.114
8	4.858	0.448	0.084	0.118
9	7.438	0.550	0.118	0.152

C. Model Evaluation

DEA method can fully consider for decision making unit itself optimal input-output scheme, and thus be able to reflect more ideal evaluation object own information and characteristics; At the same time for the evaluation of complex system into many more output analysis has unique feature[15]. Therefore, based on the DEA model can reflect the ideal of 2004-2012, different technological innovation, management innovation, market innovation under the situation of economy of scale profit condition. But DEA can handle input and output item number is not without limitation, each adding a input or output will increase several input-output ratio, leading to the DEA model identification ability to drop, so the amount of data is required. This paper applied the three inputs and one output, and the corresponding prepared 9 sets of data to participate in evaluation, the number of data with Dyson, etc in 2005 proposed evaluation criteria, which is the number of evaluation decision unit cannot under input attribute number and output attributes of product number two times, therefore is to meet the requirements of. In addition, the DEA model is the data of the objective evaluation, so can't reaction factors such as subjective intend to affect the result, so the output results should be brought into the realistic situation to carry on the analysis.

CONCLUSION

Among service-oriented manufacturing supply chain knowledge innovation, research and development capabilities, ability of innovation management, and marketing capabilities are very important. [16] From the result of DEA evaluation, in different periods, because of the three aspects of innovation in different proportion, its innovative performance results are also different. There is an optimal proportion that innovation investment is relatively effective, that is to say, in the proper time, to make proper investment decision may get the maximum benefit.

A. To Improve the Research and development capabilities
Understandable, for a manufacturing enterprise, the technical innovation is the impulsion of its survival and development. As a product and service integrated maker, the purpose of service-oriented manufacturing enterprise's knowledge innovation is not only promoting the performance of the product, but a full range of further fit the demand of customers' results. [17] It requests service manufacturing enterprise to make knowledge innovation on the basis of understanding the customer demand, namely realizing customer-oriented technology knowledge innovation.

In addition, as a supply chain system, the node enterprise's research and development capabilities will transfer to other enterprises on supply chain by knowledge sharing for free or not. Therefore, the effect of knowledge sharing between enterprises on supply chain could affect the result of technology innovation. Knowledge sharing between enterprises need certain trust foundation and knowledge sharing intention between enterprises. It can pass though a project team, established technology exchange and training.

It can make the research and development capabilities achievement satisfy diversity, personality demand of the customer that managers use customer demand as the guide of research and development capabilities[18]. Sharing technical knowledge between Marine pharmaceutical enterprises can enlarge the knowledge innovation effect, and produce a chain of knowledge innovation achievements. Such, it can not only ensure the Marine pharmaceutical enterprises supply chain knowledge innovation effectiveness, and can make knowledge innovation effect to realize optimal.

B. To Perfect the innovation management system
Marine pharmaceutical enterprises' property, composition and operation of the structure are different. [19] So for each enterprise, the effective management method is not the same. Supply chain ability of innovation management includes two levels. First, the management of enterprise on supply chain requires implement differentiation management on the basis of understanding each enterprise, to ensure the enterprise benefits. [20] At the same time, implementing systematic adjustment realize resource optimal allocation and the enterprise collaborative development. On the other hand, dealing with the node enterprise internal ability of innovation management, enterprise can profit from each other, and combined with the enterprise's own condition, then, make the most suitable management measures. [21]

Making difference to the each node enterprise management can realize management effectively. The systematic management of node enterprise knowledge innovation can realize Marine pharmaceutical enterprises' resource allocation optimization and the coordinated development between enterprises

C. To Improve Effective Marketing Capabilities
As a typical service-oriented manufacturing industry, the computer manufacturing industry is the most promising manufacturing industry. Marketing capabilities appears especially important, it's effect is the most obvious as well. [22]Marketing capabilities include discovering new customers, to develop new markets, to find the products new USES and to formulate new marketing model. In the marketing capabilities, the first step is to clear the use of the products, the performance, and the target customers. It can help making more effective marketing plan, as the target is clear. Then, the high execution efficiency can help to optimize the result. Purpose, efficiency is the foundation of the maximization in marketing capabilities.

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