Study on the Method to Improve Enterprise's Technological Innovation Efficiency

Xiaogang Shen
School of management, Henan University of Technology, Zhengzhou, China
Email: sxg200411@163.com

Abstract: As we know, the ability of technological innovation of big corporation is the determining factors for success in the fierce market competency. In order to improve the ability in technological innovation of company, many methods had been used in many fields. However, the technological innovational efficiency is the most difficult to solve. In this paper, the DEA evaluation method and a broadly census was conducted to shed light to the relationship between the intellectual property protection and technological innovation of the enterprise. The research results indicate that the proper protection of the intellectual property is necessary for the technological innovation. In order to incentive the economy growth, the intellectual property protection should strengthen in the future for the economy development.

Keywords: intellectual property right; technological innovation; core competency

1 Introduction

Under the knowledge economy background, all countries are making efforts to improve their comprehensive strength. Constructing an innovative country was taken as an important national strategy in China in order to conform to the world developing trend. In the process of building innovative enterprises, how to evaluate the performance of innovative enterprises scientifically has become the research hot spot. The resources are indispensable for the enterprise's sustainable development, while the intellectual property is the core in the several resources. How to maintain the compare advantages and develop new and high technology is an important part in the normal operation of all kinds of company. In order to study the relationship between the technological innovation and protection of intellectual property, the paper will introduce the DEA (Data Enveloped Analysis) method into the evaluation of technological innovation efficiency and then discuss the influencing factors on the technological innovation.

As we know, the transformation from input to output is one of the steps in the process of technological innovation. However, due to the multi-variables and different unit, it is difficult for the company to evaluate the technological innovation. Thus, there are some hypothesis in the analysis: for a company, (1) unless increase one or more of innovative factor input, or reduce the output of other kinds, otherwise can't increase any output any more; (2) it will must know and reduce and produce or add extra other input to keep producing and does not change to reduce a certain input, if condition (1) and (2) are also satisfied, it is efficient for the company.

2 Concepts and Features of Innovative Enterprises

2.1 The Concept of Innovative Enterprises

There is no unified standard of the concept of innovative enterprises. According to the appraisal standard of innovative enterprises, innovative enterprises are those new enterprises which possess independent intellectual property rights and the well-known brands, have strong international competitiveness, could keep innovative concept and organizational culture as the guide, take technological innovation activities as the support, independent research and development or absorption, re-innovation as means, innovate continuously so as to stimulate the sustainable development of enterprises[1].

2.2 The Features of Innovative Enterprises

Innovative enterprises take innovation as top priority and the soul of sustainable development, their features are as follow:

(1) Prominent independent innovative ability

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The independent innovation of innovative enterprises is to adjust various production factors systemically, and establish a new system which is assembled by innovative production factors to seek high economic benefits from the best combination effects. In 2007, experimental innovative enterprises increased investment in R&D, the proportion of R&D expenditures to sales exceeds 6% accounted for 46% of these enterprises, all of these experimental enterprises had established R & D institutions, among of them, there 23 enterprises had be allowed to establish State Key Laboratory, become the national R&D platform of key field.[2].

(2) Strong sustained profitability

The main purpose of technological innovation in innovative enterprises is to get enormous economic benefits, which is also the most important measure criteria of the innovative achievement. The competitive advantage of innovative enterprises manifested as the monopoly right of the production, operation and marketing of innovative products, enterprises can obtain excess profit for a certain period; gain greater economic benefits from the transferring of ownership and usufruct of intellectual property outcome. Some innovative enterprises, such as Huawei, ZTE, obtain much higher profits than other enterprises relying on their higher R&D ability [3].

(3) Well comprehensiveness innovative ability

The innovation of innovative enterprises covers every levels of enterprises development, include technical innovation, system innovation, management innovation, organization innovation, market innovation and culture innovation, and so on. There are close inherent connection among different innovation which formed an organic whole[4]. In order to accomplish comprehensive and systematic innovation, innovative enterprises must take technological innovation as the focus, the system innovation as the base, the management innovation as the guarantor, the market innovation as the outlet, cultural innovation as the promotion.

(4) Strong continuous innovative ability

In innovative enterprises, innovation is not one-time, temporary or intermittent, but sustainable. Innovation process is a dynamic continuous process, a generalized technological innovation include four basic stages: ideas innovation, research and development, product forming and marketization. such as the Haier Group, its innovative process include opportunity identification, thought formation, problem solving, batch production, development and the application and extension of new technologies[5].

(5) High level of innovative achievements property right transformation

Innovative enterprises formed intellectual property rights in process of innovating, the property right transformation in the whole process of innovation has played a very important role, is also the main measure indicator and the core of competitiveness in innovative enterprises[6]. Any product innovation is only the material carriers, only the independent intellectual property rights is the final purpose of innovation. Access to core technology and strong brands of their own intellectual property rights is the development aim of Chinese innovative enterprises [2].

3 The Design of Efficiency Evaluating Indicator of Technological Innovation

3.1 Indicators

The indicator of the paper is shown as the Table1.

3.2 DEA

Data Envelopment Analysis (abbreviated as DEA) is a rather effective method for estimating efficiency which has many concrete models. It is an approach that fundamentally based on the work by Farrell (1957) then proposed by Charnes and Cooper(1978) to construct a best-practice frontier without specifying production technology. Unlike traditional analysis techniques that look for an average path through the middle points of data series, DEA looks directly for a best-practice frontier within the data. Using a nonparametric linear programming technique, DEA takes account of all the inputs and outputs as well as differences in technology, capacity, competition, and demographics and compares individual performance with the best-practice (efficiency) frontier.

The principle of DEA is supposing that there are some decision making Units (DMU), each DMU_j(j=1，…，n) has corresponding input variable x_{ij} (i =1，…，m)and output variable y_{rj} (r=1，…，s)[23], and the efficiency of a certain DMU is determined by equation (1):

$$h_j = \sum_{r=1}^{s} u_r y_{rj} \Big/ \sum_{i=1}^{m} v_i x_{ij} \quad j = 1,2,...,n \tag{1}$$

In equation (1), v_i (i=1，…，m) and u_r (r=1，…，s) are respective weights of x_{ij} and y_{rj}, and they are determined by following mathematical programming:

Table 1. Technological innovation and Performance evaluation indicators

Evaluating Indicator		Variable	Sampling indicator			Weight of indicator		
			Large	Medium	Small	Group 1	Group 2	Group 3
Input	R&D input for new product	X_1	514	500	245	0.333	0.381	0.4
	R&D Worker for new product	X_2	78	45	24	0.333	0.333	0.333
	Assets	X_3	1500	800	300	0.333	0.286	0.267
Perform-ance	Share of new product (%)	Y_1	45	37	29	0.25	0.211	0.189
	Growth rate of New product	Y_2	10	15	21	0.25	0.237	0.216
	Renewal period of main Product (Year)	Y_3	14.6	22	32.5	0.25	0.263	0.27

$$h_0^* = \max_{v_i, u_r} h_0$$

$$\text{s.t.} \quad \begin{cases} h_j \le 1, j = 1,...,n \\ v_i, u_r \ge 0 \end{cases} \tag{2}$$

In equation (2), $h_j = \sum_{r=1}^{s} u_r y_{r0} \Big/ \sum_{i=1}^{m} v_i x_{i0}$ is the ratio of total input and total output of DMU_o (effective index), o∈{1，…，n}. x_{i0} and y_{r0} respectively represent input i and output r of DMU_o. Through variable 'o' changing among {1，…，n}, we can get the best weight and the value of h_j. Obviously, the larger the DEA value is, the more effective DMU is. If $h_j = 1$, then DMU_j is relatively effective.

Let $t = 1 \Big/ V^T X_0$ $\omega = tV, \mu = tU$ ， $U = (\mu_1, \mu_2, ..., \mu_s)^T$ is coefficient of input index, $V = (v_1, v_2, \ldots v_m)^T$ is coefficient of output index. Making use of Charnes-Cooper transform, equation can be converted into linear programming question:

$$\max \ V_p = \mu^T Y_o$$

$$s.t. \begin{cases} -\mu^T Y_j \ge 0, 0 \le j \le 1 \\ \omega^T X_o = 1 \end{cases} \tag{3}$$

Its dual style is:

$$\theta_o^* = \min_{\theta_o, \lambda_j} \theta_o$$

$$\text{s.t.} \quad \begin{cases} \sum_{j=0} \lambda_j x_{ij} + s_i^- = \theta_o x_{io} \\ \sum_{j=0} \lambda_j y_{rj} + s_r^+ = y_{ro} \\ \lambda_j \ge 0, s_i^- \ge 0, s_r^+ \ge 0 \\ i = 1,2,...,m \quad r = 1,2,...,s \end{cases} \tag{4}$$

If abovementioned optimal solution θ_0, λ_j(j=1,2,…,n) can satisfy:

(1) $\theta_o = 1 \Rightarrow DMU_o$ is weak-effective;

(2) $\theta_o = 1 \bigcap s_i^- = 0 \bigcap s_i^+ \Rightarrow DMU_o$ is effective;

(3) $\theta_o < 1 \Rightarrow DMU_o$ is not effective.

4 Empirical Study

4.1 Data Collection and Estimation

In order to study the validation of the above analysis, a market survey is conducted in key nation-own enterprises, the family enterprises and other listed company. The following equation is estimated.

$$TIE = A + \sum_k B_k ES_k + C * EDD + \sum_i D_i * IM_i + IPP_i \tag{5}$$

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TIE is the technological innovation efficiency, A is a coefficient, ES is a virtual variable. EDD is the education experience. IM is the way of innovation and the IPP is the Intellectual Property Protection.

The estimation is shown in Table 2.

4.2 The relation between the IPP and Technological Innovation

(1) If the intellectual property rights are protected properly, it will provide unexhausted sources for the enterprise's technological innovation

Table 2. The estimation results

Variable	Estimation	S.T V	T	Significa-tion
A	0.619	0.054	15.34	**
ES	0.0034	0.024	1.45	*
IPP	0.0023	0.032	4.56	**

The patent protection institutions in the protection system of the intellectual property right has offered the most important motivation force and incentive mechanism for technological innovation, according to current method and relevant provisions of the law or regulation of our country in the world. The post inventor can obtain corresponding remuneration in the unit implement the income of the patent, this is a kind of incentive mechanism to the scientific and technical personnel who finish technological innovation, reflecting that participates in knowledge or technology, building the good environment attracting talents, retaining staff.

(2) Protecting the intellectual property right is to protect enterprise's core competency

Considerate that the process of merging constantly in the international domestic market, the core competency of an enterprise, especially the new high-tech enterprise, is the technological advantage in the same industry. If an enterprise has central technological advantages, it can obtain the monopoly position and right of disposition in the technological competition. Meanwhile, it can obtain more businesses opportunity. Obviously, if does not pay attention to the protection of enterprise's technological innovation achievement, their intellectual property would be infringed probably by others and then lose this kind of advantage.

(3) Protecting the intellectual property right is to protect the market competition advantage

Market economy is competing economy. However, the competition should be legal, thus, protecting the intellectual property right can protect the market competition advantage of enterprises. The patent system in intellectual property protection is based on invention and creation on technology, under the protection of the patent law, regard monopolizing the market as the main characteristic. Today, the intellectual property protection internationalizing and tariff barrier removed gradually, the market competitive advantage can't obtained only by high technological achievement or produce good and inexpensive product. Under the prerequisite that must obtain in accordance with the law the patent right of it and be protected conscientiously according to the legal provisions, could form one's own unique market competition advantage finally.

5 Conclusions

In order to growth gradually and obtain the competitive advantage, it is necessary for the enterprise to maintain the high efficient technological innovation. The protection of the intellectual property and the construction of the all-directional and reliable protection system is important for the creation of the friendly marketing environment. Only through the effective protection of the intellectual property right, the good, resting and safety technological environment could be built that is a factor for the technological innovation achievements. As the protected intellectual property rights (technological innovation achievement) can be transferred into the core competency, enterprises, especially new high-tech enterprises, could survive and develop in the fierce market competition day by day.

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