Research on Influence of Enterprise Cooperative Ability in the Process of Industry-university-research cooperation

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Abstract: This paper defines the connotation of enterprise cooperative ability based on the analysis of enterprise resource integration among the industry-university-research cooperation (IURC) innovation network. The corresponding questionnaire was designed and a large number of researches was conducted,Factor analysis was used to identify the four dimensions of the enterprise collaboration capabilities, namely knowledge innovation, partnership, atmosphere of innovation and enterprise information. Based on the above, the present research built the model of the cooperative ability of the enterprise among the industry-university-research innovation network, which lays a theoretical and empirical foundation for the measurement of enterprise synergic capability in the innovation network.

1. Introduction

Knowledge has become the premise and foundation while the organization faces the fierce market competition in the new era with the arrival of the knowledge economy. It requires that the enterprise to form a complementary-knowledge partnership with universities or research institutes for the purpose of realizing the knowledge innovation of the organization and establishing a core competence. However, there are many failed cases of industry-university-research cooperation(IURC) in practice. Through analysising on them, it is found that they normally couldn’t make the full use of individual advantages of different subjects to form an integrated cooperative effectively. Therefore, enterprise cooperative ability is one of important reasons [1]. It has been proposed in one of the innovative meeting of industry-university-research cooperation in china that we need to highlight the dominant role of enterprise in industry-university-research cooperation. As the mainstay of industry-university-research innovative network, the enterprise masters the latest market information, which will effectively promote knowledge and technique to realize market value. Besides, enterprise cooperative ability plays a crucial role in innovative performance of organization [2]. The stronger enterprise cooperative ability is, the better for the reasonable distribution and efficient transfer of innovative resources, including the organization information and the knowledge of industry-university-research organization. Therefore, it is good for enterprise, the dominant of in industry-university-research cooperation, to correctly understand its own cooperative ability and immediately adjust its cooperative behavior by exploring the constitute and measure method of enterprise cooperative ability in industry-university-research innovative process, to make scientific and objective evaluation of enterprise cooperative ability in industry-university-research innovative organization and to find reasons for inadequate cooperative ability. This way, the enterprise can achieve the goal of combining the technique and market in cooperation and innovation process with universities and scientific research institutes.

2. Research Status

With the industry-university-research cooperation progressing constantly in depth, the number of the factors that guide the cooperation between enterprises, universities and institutes are increasing. Researches of domestic and abroad scholars on this topic concentrate on the following aspects:

(1) Motivation and model of IURC

Markard(2012) researched IURC purpose obtained based on technique through empirical analysis and found that most enterprises took cooperative innovation with universities and institutes to obtain more advanced industrial technique to enhance their own competences [3];Chen Yanyun, (2014) researched industry-university-research cooperation model based on dominant of local universities and proposed industry-university-research alliance innovation model on the basis of "four techniques cooperation" and with the carrier of "industry strategy alliance" through empirical analysis;

(2) Influence factors of IURC

Muller-Seitz (2012) explored the factors influencing the cooperation between suppliers of profession knowledge and enterprises in manufacturing industry and service companies. Comparing enterprises'high absorbability, richer social capitals, internet capacity and greater innovation determination, the suppliers of profession knowledge valued enterprises'openness more and inclined to cooperate with more open enterprise [4].Lee J (2014) compared the activeness of the technique transfer of three scientific research centers in Singapore and found that participating in R&D project is an effective way of enabling the high involvement, technique transfer and strong will of enterprises.Jianzhong Xu(2015) proposed that enterprises should scrutinize their cooperative abilities from six dimensions, including suppliers, customers, competitive enterprises, government, research organization and intermediate agency when he was studying the relationship among enterprise cooperative ability, internet location and technique innovative performance [5].

(3) The performance measure of IURC

Sermon (2007) analyzed the cooperation situations of 33 universities and enterprises in 12 countries and measured the effectiveness of IURC from three aspects: technique correlation, previous cooperation and geography distance. Xiong Chan and his colleague (2014) tested the operation efficiency of the hi-tech start-up enterprises by using basic DEA model and improved DEA cross-efficiency ordering model.Kai Sun(2011) used Pearson correlation and stepwise regression analysis to analyze the influence of scientific innovation input on innovation performance of the entire Chinese hi-tech industry and its 5 typical industries [7].

In summary, the innovation method of IURC has become the hot spot of both the theoretical and practice researches. However, the current research on enterprise cooperative ability focus mainly on subsidiary companies with in the inner group of the coop, different industries and inner areas due to the difference of research emphasis and research views and enterprise cooperative ability in the IURC process remains in theoretical discussion and connotation analysis phase. There is no uniform dimension division standard on researches related to the cooperative ability nor any mature measurements. This paper divides enterprise cooperative ability of IURC into internal and external cooperation ability, where the external mainly refers to cooperative ability to the entire internet resource of IURC and the internal mainly refers to the support force of the enterprise itself to cooperative innovation.

3. Model Building of Measure of Enterprise Cooperative Ability in IURC

3.1 Scale Design of Identifying Core Enterprises of Technical Innovation Internet in Power-Dependence Perspective. Combing with the development process of Churchill composite scale, we made experts interview and enterprise survey based on previous research achievements of Bai (2009) [8], He(2013) [9] and initially formed a 32 structured items of enterprise cooperative ability in the process of evaluating industry-university-research cooperation. We selected several experts and scholars on this topic and asked them to estimate the initially formed structured items based on depth interview. Through adjustment and abstraction, we formed the 25 structured items , And then, we formed a questionnaire.

We structuralized the formed 25 items into Likert 5-point scale and implemented the analysis on the recalled questionnaires, in which items with correlation index less than 0.7. And then, we obtain 20 items to constitute the enterprise cooperative ability.

Table 1. Initial scale for measuring enterprise cooperative ability in the process of industry-university-research cooperation

No.	Measure items
V1	Enterprises are able to create new knowledge through cooperation with partners.
V2	Enterprises are able to immediately obtain technique information of partners.
V3	Enterprises are able to terminates cooperation with adverse partners.
V4	Enterprises are able to exchange with partners frequently.
V5	Enterprises are able to transfer information among partners in proper forms.
V6	Enterprises organizational culture is good for cooperative innovation.
V7	Enterprises are able to correctly find proper partners.
V8	Enterprises are able to immediately obtain market information and grasp development opportunity.
V9	Enterprises are able to find and obtain needed knowledge quickly from partners.
V10	Enterprises have special departments and personnel to collect and handle information.
V11	New knowledge of enterprises is able to fully understood and accepted by partners.
V12	Enterprises are able to build good cooperation relationship with partners.
V13	Hardware facilities of enterprises are able to guarantee cooperation innovation.
V14	Leaders of enterprises highlight enterprise cooperative innovation.
V15	Enterprises are able to quickly obtain the latest information of the industry.
V16	Enterprises are able to quickly guide the development of new products with digested information.
V17	The existing system of enterprises supports enterprise cooperative innovation.
V18	Enterprises are able to fully share knowledge with partners.
V19	Enterprises are able to effectively apply possessed knowledge to actual working.
V20	Enterprises have special information exchange mechanism.
V21	Enterprises are able to evaluate and maintain profits of partners well.
V22	Enterprises are able to immediately find and solve existed conflicts with partners.
V23	Enterprises are able to integrate knowledge of them and partners.

3.2 Exploratory Factor Analysis. The Kaiser- Meyer-Olkin value is 0.709; and Chi-Square value by Bartlett's test of Sphericity is 3502.402, $P=0.000<0.001$. The results of two examinations show that the data is suitable for factor analysis

Table 2.KMO and Bartlett's examination

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.709
Bartlett's test of Sphericity	Approx.Chi-Square	3502.402
	df	190
	Sig	.000

4 factors are selected after statistics and analysis based on above standard, whose eigenvalue accumulated variance contribution rate is 73.124%. At the same time, items with loading less than 0.4 and with similar loading on every factor are removed At last, we removed 3 items and reserved 17 items and 4 factors. The reserved items are shown in table 5 and results of factor analysis are seen in table 3. Interpretation ratio of factors to variance are shown in table 4.

Table 3 factor loading matrix after orthogonal rotation

Item	Factor 1	Factor 2	Factor 3	Factor 4
V1	.853			
V9	.887			
V11	.777			
V18	.779			
V23	.789			
V3		.891		
V4		.908		
V7		.753		
V22		.916		
V6			.873	
V13			.799	
V14			.867	
V17			.874	
V5				0.854
V8				0.798
V10				0.654
V15				0.697

Table 4 Interpretation variance summation

Component	Initial Eigenvalues			Extraction Sums of Squared Loading		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Factor 1	4.401	22.003	22.003	4.401	22.003	22.003
Factor 2	3.859	19.296	41.299	3.859	19.296	41.299
Factor 3	3.550	17.751	59.049	3.550	17.751	59.049
Factor 4	2.815	14.074	73.124	2.815	14.074	73.124

According to the results of the analysis, factor 1 consists of items V1, V9, V11, V18 and V23 that are cooperative behaviors related to innovative knowledge, so it is named after "innovative knowledge"; factor 2 consists of V3, V4, V7 and V22 that concentrates on finding, exchange and solution of conflicts in cooperative relationship, so it is named after "cooperative relationship"; factor 3 is identified by V6, V13, V18 and V17 that mainly describes enterprises' construction of innovative atmosphere including culture, system and hardware in favor of enterprises' implementation of cooperative innovation, so it is named after "innovative atmosphere"; and factor 4 consists of V5, V18, V10 and V15 that describes enterprises' cooperative behaviors on information in cooperative innovation process, so it is named after "enterprise information".

Table 5 Final scale for measuring enterprise cooperative ability in the process of industry-university-research cooperation

Structure	No.	Items
Innovative Knowledge	Cpc01	Enterprises are able to create new knowledge through cooperation with partners.
	Cpc02	Enterprises are able to find and obtain needed knowledge quickly from partners.
	Cpc03	New knowledge of enterprises is able to fully understood and accepted by partners.
	Cpc04	Enterprises are able to fully share knowledge with partners.
Cooperative relationship	Cpc05	Enterprises are able to integrate knowledge of them and partners.
	Cpc06	Enterprises are able to terminates cooperation with adverse partners.
	Cpc07	Enterprises are able to exchange with partners frequently.
	Cpc08	Enterprises are able to correctly find proper partners.
	Cpc09	Enterprises are able to immediately find and solve existed conflicts with partners.
Innovative atmosphere	Cpc10	Enterprises organizational culture is good for cooperative innovation.
	Cpc11	Hardware facilities of enterprises are able to guarantee cooperation innovation.
	Cpc12	Leaders of enterprises highlight enterprise cooperative innovation.
	Cpc13	The existing system of enterprises supports enterprise cooperative innovation.
Enterprise information	Cpc14	Enterprises are able to transfer information among partners in proper forms.
	Cpc15	Enterprises are able to immediately obtain market information and grasp development opportunity.
	Cpc16	Enterprises have special departments and personnel to collect and handle information.
	Cpc17	Enterprises are able to quickly obtain the latest information of the industry.

4. Conclusion and Expectation

To sum up, this paper analyzed the enterprise cooperative ability from two perspectives of the enterprises' cooperative capacity to internet resources and internal support force of the enterprises to cooperative innovation. Based on the above, 4 dimensions of evaluating enterprise cooperative ability was obtained, including innovative knowledge, cooperative relationship, innovative atmosphere and enterprise information. The accrding measurement was developed based this four factors model. And the empirical analysis shows that the measure model built in this paper has excellent reliability and validity. The research structure based on the evidence offers experience and reference for the measurement of the enterprise cooperative ability in IURC.

The limitation of the present study is mainly due to the topic restrictions: (1) the measurement on enterprise cooperative ability in the process of IURC of this paper was the very basic. This paper proposed and verified the measure model of enterprise cooperative ability in the process of industry-university-research cooperation, but it didn't analyze the relationship among the level 1 indexes, which could be analyzed further in the future analysis; (2) this paper measures only the enterprise cooperative ability in the process of industry-university-research cooperation without

considering the influencial factors, such as the development level of regional economy, the improvement degree of laws and the regulations and strengthes of the policy support of the region, etc. Therefore, the influencial factors of enterprise cooperative ability in the process of industry-university-research cooperation and its approaches may be one of the major research directions in the future.

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