

Research on the Evaluation of Universities Collaborative Innovation Center in Henan Province Under the Perspective of Two-Dimensional Matrix Performance: Based on the Analysis of 10 Sample Data of Universities Collaborative Innovation Centers

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Abstract

How to promote the collaborative innovation center performance and to smoothly promote the collaborative innovation center to achieve the desired objectives is one of the main problems facing the collaborative innovation management. The two-dimensional evaluation of key break through of science and technology-completion rate of construction target, system mechanism reform and innovation effectiveness-collaborative innovation level are multidimensional evaluation cores of collaborative innovation center. Using the Boston Matrix model to build a two-dimensional performance evaluation of collaborative innovation center model, the construction target completion degree and construction effectiveness, innovation synergy level are chosen as the first class index sets; scientific research, scientific and technological cooperation platform as the second class index sets; patents, team building as the third class index sets, choosing 10 colleges and universities collaborative innovation centers as the research samples. The conclusion shows that the evaluation and rank of collaborative innovation centers under the perspective of two-dimensional performance matrix is clear and simple, which can be used to complement the evaluation of the universities collaborative innovation centers.

Key words: Two-dimensional matrix; Henan Province; Universities collaborative innovation center

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INTRODUCTION

In March 2012, Ministry of Education and Ministry of Finance jointly issued "Opinion about Implementation of Innovation Ability Promotion Plan of Institution of Higher Education", explicitly proposing to give full play of multidisciplinary, multi-function advantage of universities and to build a new mode and new synergetic innovation mechanism. Under this background, many universities in China are actively building their own collaborative innovation platform. In November 2012, there were 13 collaborative innovation centers, which include the advanced materials and processing collaborative innovation centers whose leading unit is Zhengzhou University, identified in Henan Province. In April 2013, Ministry of Education identified 14 collaborative innovation centers in high-end research field. The food corps collaborative innovation center, which includes Henan Agricultural University, Henan University of Technology and Henan Academy of Agricultural Sciences, is among collaborative innovation centers. In May 2013, 12 collaborative innovation centers, which include new town construction technology, efficient use of water resources of Central Plains Economic Zone and security engineering, modern animal husbandry, aviation economic development collaborative innovation centers, identified in Henan Province. How to standardize and strengthen performance management of the collaborative innovation center, and to implement the "Opinion about Implementation of Innovation Ability Promotion Plan of Institution of Higher Education", and to develop phased performance evaluation and management plan, develop a phased scientific evaluation mode, evaluation process, evaluation index system and criteria, the corresponding incentive and restraint policy, realize the expectant target is one of main problems facing the collaborative innovation management in Henan Province. Under this background, this paper proposes an evaluation model of collaborative innovation center under the perspective of two-dimensional matrix based on the 10 sample

data of universities collaborative innovation centers, aimed to provide reference for evaluation of universities collaborative innovation center.

1. MULTIDIMENSIONS OF EVALUATION CONTENTS OF UNIVERSITIES COLLABORATIVE INNOVATION CENTERS

The evaluation contents of universities collaborative innovation centers evaluation include four aspects of construction target completion rate and construction effectiveness, innovation synergy level, key problems of science and technology (or major task), system mechanism reform and innovation effectiveness. These four aspects constitute the performance system of universities collaborative innovation centers stage construction, but the status of these four aspects in this system are different, and key breakthrough of science and technology (or major task) is important in innovation synergy management, the construction target completion rate and the construction achievements appraisal is an important manifestation of key breakthrough in science and technology. What needs to point out is, the collaborative innovation center participant which previously is as the independent innovation individual, in addition to solve the key scientific issues surrounding the collaborative innovation platform (or important task), engage in scientific research and other collaborative activities, may also to solve the technical innovation activities which are not close in correlation. Therefore, the two-dimensional evaluation of Key breakthrough of science and technology-Completion rate of construction target is a part of multi-dimension evaluation of collaborative innovation centers. In addition, there are internal relations and external consistency between cooperative system mechanism reform and innovation cooperative level, the system mechanism reform and innovation of collaborative innovation center aim to improve the cooperative innovation level between units, whose performance directly reflects on the cooperative innovation level. System mechanism reform

and innovation performance, collaborative innovation level are measures of collaborative innovation center as a resource, information sharing platform, so the two-dimensional evaluation of system mechanism reform and innovation effectiveness-collaborative innovation level can be as another part multi-dimensional evaluation of universities collaborative innovation center.

2. THE TWO-DIMENSIONAL MATRIX PERFORMANCE EVALUATION MODEL CONSTRUCTION OF UNIVERSITIES COOPERATIVE INNOVATION CENTER

2.1 The Design of Matrix Evaluation

The matrix evaluation is to find pair factors from the multidimensional problems in two dimension and four quadrants mode, to analyze and evaluate the related factors and explore the problem (Feng, 2013). In Boston Matrix which uses the two dimensional relationship of the market growth rate and relative market share, divided the matrix into four quadrants of the stars class, cows class, dogs class and the problem class to evaluate the enterprise product competitiveness. Because its operation is simple and clear, it has been widely applied in the field of social science, financial analysis, research and evaluation of decision-making innovation strategy (Xin, 2010; Wang, Liang, & Hou, 2009; Zhang, Yuan, & He, 2008; Bao, Jian, & Hoki, 2007), etc.. This also provides useful idea for this paper. The construction of the specific two-dimensional matrix performance evaluation model is as follows.

First of all, We establish the basic matrix evaluation model from two aspects of two-dimensional evaluation of “key breakthrough of science and technology-Completion rate of construction target” and the two-dimensional evaluation of “system mechanism reform and innovation effectiveness-collaborative innovation level”, with X, Y for the two-dimensional abscissa and ordinate, and the evaluation space is divided into I, II, III, IV regions.

Table 1
Two-Dimensional Matrix Performance Evaluation Form of Universities Collaborative Innovation Center

Evaluation Region	The basic evaluation matrix of “key breakthrough of science and technology-completion rate of construction target”		The basic evaluation matrix of “system mechanism reform and innovation effectiveness-collaborative innovation level”	
	X ₁	Y ₁	X ₂	Y ₂
I	High completion rate of construction target	Good progress of key scientific technology research	Perfect system mechanism reform and innovation system construction	High level of collaborative innovation
II	Not high completion rate of construction target	Good progress of key scientific technology research	Not perfect system mechanism reform and innovation system construction	High level of collaborative innovation
III	Not high completion rate of construction target	General progress of key scientific technology research	Not perfect system mechanism reform and innovation system construction	Low level of collaborative innovation
IV	High completion rate of construction target	General progress of key scientific technology research	Perfect system mechanism reform and innovation system construction	Low level of collaborative innovation

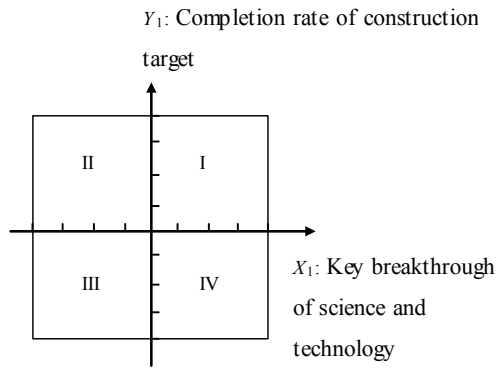


Figure (a) The basic evaluation matrix of “key breakthrough of science and technology-completion rate of construction target”.

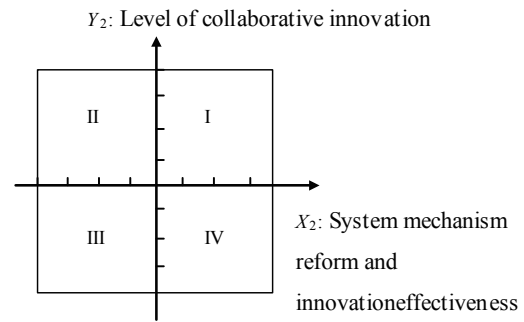


Figure (b) The basic evaluation matrix of “system mechanism reform and innovation effectiveness-collaborative innovation level”.

Figure 1
Two-Dimensional Matrix Performance Evaluation

2.2 The Design of Evaluation Index

According to the “scientific”, “comprehensive”, “accessible” and “practical” principle and the overall target of the cultivation and development of collaborative innovation center, we choose “completion rate of construction target”,

“innovation synergy level”, “key breakthrough of science and technology” and “the system mechanism reform and innovation” as the first class index and design the performance of evaluation index system of universities collaborative innovation center. It is shown in Table 2.

Table 2
The Design of Evaluation Index of University Collaborative Innovation Center

The first class index	The second class index	The third class index
The construction target completion rate and construction effectiveness (u_1)	Scientific research (u_{11})	The platform of science and technology
		Process, product and standard
	The development of the discipline (u_{12})	Patent
		Reward
		The thesis, monograph
		Research project
Team construction (u_{13})	The key discipline	
	New cross discipline	
Talent cultivation (u_{14})	The degree conferring points	
	Team building	
	High level talents convergence	
International cooperation (u_{15})	Youth talent cultivation	
	The postgraduate education	
	High level talents cultivation	
Social service (u_{16})	International conference	
	Studying abroad, visiting scholar	
	Platform, project and other characteristic cooperation	
	Industry service	
		Technical training
		Technical guidance
		Horizontal project and the others

To be continued

Continued

The first class index	The second class index	The third class index
Level of collaborative innovation (u_2)	The platform of science and technology (u_{21})	The cooperation of science and technology platform and synergy level
	Joint personnel training (u_{22})	Mutual recognition of credits, mutual hiring of tutors, the quantity and quality of interaction of students
	Resource sharing (u_{23})	The numbers and effects of sharing laboratory, electronic database, training and practice base
key breakthrough of science and technology (u_3)	If there is a major original innovation achievements in scientific research at present or not (u_{31}); If representative foundational research results is timely transformed and applied or not (u_{32}); If there is a high level academic activities related to “the key scientific technology or theoretical problem” or not (u_{33}); Under the current progress of the study, if it can solve the “the key scientific technology or theoretical problem” at the end of the construction period or not (u_{34});	
system mechanism reform and innovation (u_4)	The organization model of collaborative innovation center and its management system establishment and operation (u_{41}); The personnel appointment, evaluation, incentives, flows and the other personnel system reforms and their actual operation(u_{42}); Reform and implementation of talents cultivation mechanism with great demand (u_{43}); The organizing and carrying out of collaborative innovation tasks (u_{44}); The integration and use of innovation resources which include platform, base, achievement, information and so on (u_{45}); The substantive support and the input use conditions of the leading universities, mainly participating units and the social parties (u_{46});	

In order to sort performances of collaborative innovation centers, we invite experts who score the second class index according to Table 2. The sum of scores of the second class index is score of the first class index. The setting of the score of the i th first class index of the evaluation object j is $u_i^j (i = 1, 2, \dots, m; j = 1, 2, \dots, n)$, and the standardizing u_i^j is as follows.

$$v_j^i = \begin{cases} \frac{u_i^j - \bar{u}_i^j}{\max u_i^j - \bar{u}_i^j} u_i^j \geq \bar{u}_i^j \\ \frac{\bar{u}_i^j - u_i^j}{\bar{u}_i^j - \min u_i^j} \bar{u}_i^j \geq u_i^j \end{cases}$$

We set v_{x1}^j, v_{y1}^j respectively as the abscissa and ordinate of basic evaluation matrix coordinates of “key breakthrough of science and technology-completion rate of construction target”, set v_{x2}^j, v_{y2}^j respectively as the abscissa and ordinate of basic evaluation matrix coordinates of “system mechanism reform and innovation effectiveness-collaborative innovation level” and get the evaluation region of the evaluation object j .

3. THE EMPIRICAL ANALYSIS OF PERFORMANCE EVALUATION OF 10 UNIVERSITIES COLLABORATIVE INNOVATION CENTERS IN HENAN PROVINCE

3.1 The Construction and Calculation of Evaluation Matrix

There were 12 universities collaborative centers in the first run (in 2012) in Henan Province. According to the

principle of comparability, we choose 10 universities collaborative innovative centers from them as evaluation objects, and the standardized data are shown in Table 3.

Table 3
The Standardized Data of Performance Evaluation Results of Universities Collaborative Innovative Centers in Henan Province

	V_{x1}	V_{y1}	V_{x2}	V_{y2}
A	0.444444	1	1	0.090909
B	-0.25926	-1	-1	0.090909
C	-0.44444	-0.44444	-0.47368	-1
D	0.444444	0.166667	1	-0.47368
E	0.444444	1	1	1
F	0.444444	1	1	1
G	-1	-1	-1	0.090909
H	-0.07407	-1	1	0.090909
I	-0.07407	1	1	1
J	1	1	-1	-0.47368

According to multidimensional evaluation matrix design and data in Table 3, we can get the two-dimensional matrix Figures (see Figure 2-a and Figure 2-b) of 10 universities collaborative centers, and the specific classification are shown in Table 4.

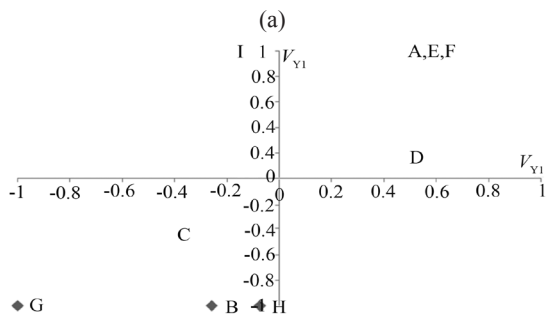


Figure (a) Basic evaluation matrix of “key breakthrough of science and technology-completion rate of construction target” of universities collaborative innovative centers in Henan Province

Figure 2
Basic Evaluation Matrix

Table 4
Two-Dimensional Evaluation Regions Table of 10 Universities Collaborative Innovation Centers in Henan Province

Evaluation Regions	Basic evaluation matrix of “key breakthrough of science and technology-completion rate of construction target”	Basic evaluation matrix of “system mechanism reform and innovation effectiveness-collaborative innovation level”
I	A, D, E, F, J	A, E, F, H, I
II	I	B, G
III	B, C, G, H	C, J
IV	—	D

3.2 The Analysis About the Evaluation Result

(a) In the 10 universities collaborative innovation centers in Henan Province, A, E, F fell in the I evaluation region in the basic two-dimensional evaluation regions of “key breakthrough of science and technology-completion rate of construction target” and also of “system mechanism reform and innovation effectiveness-collaborative innovation level”. These three universities collaborative centers have good performance in all fields, which include key scientific technological breakthrough, construction target completion rate, system mechanism reform and innovation effectiveness and collaborative innovation level, and they are in the first evaluation level of universities collaborative innovation centers. C fell in the III evaluation region in the basic two-dimensional evaluation regions of “key breakthrough of science and technology-completion rate of construction target” and also of “system mechanism reform and innovation effectiveness-collaborative innovation level”. It has no good performance in all fields and is in the third evaluation level of universities collaborative innovation centers. The rest universities collaborative innovation centers which include D, B, G, H, I, J and each have different advantages and disadvantages in key breakthrough of science and technology, completion rate of construction target, system mechanism reform and innovation effectiveness and collaborative innovation level. All of them are in the second evaluation level of universities collaborative innovation centers.

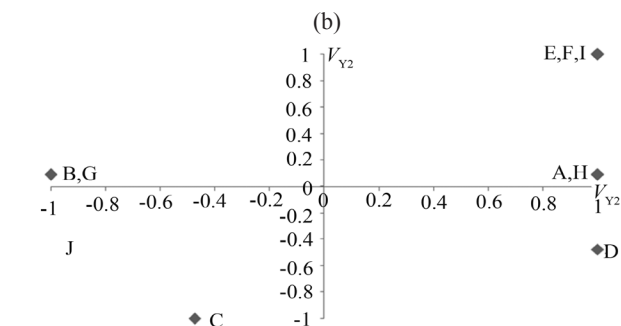


Figure (b) Basic evaluation matrix of “system mechanism reform and innovation effectiveness-collaborative innovation level” of universities collaborative innovative centers in Henan Province

(b) There are 70% of universities collaborative centers that are in I and III evaluation regions respectively in the basic two-dimensional evaluation matrix of “key breakthrough of science and technology-completion rate of construction target”, and 90% of university collaborative centers in the same evaluation regions in the basic two-dimensional evaluation matrix of “system mechanism reform and innovation effectiveness-collaborative innovation level”. Therefore, from the overall perspective, key breakthrough of science and technology and the construction target completion condition are positively related in relationship, also the same in the relationship between system mechanism reform and innovation effectiveness and innovation synergy. This result shows that universities collaborative innovation centers in Henan Province support well the solving out of key scientific problems, but parts of construction target assessment index may be not closely related to key scientific problems, and become redundant indexes. There are strong positive correlation between system mechanism reform and innovation effectiveness and collaborative innovation level, which shows that system mechanism reform is the key factor of innovation synergy among innovation center participants and is also the primary construction task of universities collaborative innovation centers at the same time, it can break the innovation “fence” and contribute to the innovation achievements by system mechanism reform and innovation.

CONCLUSION

Universities collaborative innovation center is a newly emerging thing in higher education reform in China and many problems need to be solved. But due to the synergistic innovation evaluation involves extensive contents; it is complex in the evaluation and assessment of universities collaborative innovation center. The rank and assessment of collaborative innovation centers by the scoring system under the perspective of two-dimensional matrix is simple in operation and clear in result. However, there is not a simple additive relationship in all aspects of construction effectiveness in these collaborative centers, all aspects affect each other. The evaluation method of two-dimensional matrix makes the evaluation result reflect the inherent relation of the evaluation index, and the mutual restriction of evaluation indexes, it can be a useful supplement evaluation of universities collaborative innovation centers.

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