Research on Grey Cluster Evaluation Model and its Application of University Core Competence

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Abstract Under the background of informationization, modernization and globalization of the higher education ,the core competence is the foundation of university development. How to assess and enhance core competitiveness is the strategic initiatives to determine the survival and development of University. The purpose of this paper is to answer what its constituent elements is and how to evaluate it Firstly, the article determined the index system of core competitiveness evaluation of universities on. the basis of analyzing its constituent elements. Secondly, according to the grading score given by different experts on the various indicators, the indicator sample matrix was structured, the whitening weight function was established and the gray clustering evaluation coefficient was determined. Lastly, the comprehensive grey cluster evaluation of university core competence was conducted by using fixed weight method. The innovative points of this paper consist in having established the Grey clustering evaluation model of university core competence and having provided a new judgment standard in order to evaluate its core competitiveness

Key words University core competence; Evaluation indicator ; Grey Cluster Evaluation Model

1 Introduction

Since the U.S. management expert C.K.Prahlad and Gray Hamel (1990) first proposed core competence theory, the theory has increasingly become continuing hot issue of concern of business management and education management and many other research area**s.** In recent years, the research about university core competence and its evaluation has made many valuable theoretical results. For example, Zhong Weidong (2007） established evaluation model of the university core competence based on the AHP. Chen Jin,Wang Pengfei (2009) from the angle of education, research, and social functions built the evaluation system of university core competence. .At a new perspective, this article has studied university core competence evaluation by using grey system theory in order to enhance the core competitiveness of Chinese universities and to provide a useful ideas and methods for its evaluation.

2 University Core Competence Evaluation System

University core competence assessment is a multi-level multi-objective problem. The first problem to be solved is to select evaluating indicator. According to the objective requirements and characteristics of university core competence evaluation, the design principles of evaluating indicator mainly have feasibility principles; comprehensive principles; simple principle; comparability principle and continuity principle.

In order to conduct a comprehensive and integrated assessment on the core competence of university from four aspects such as disciplines competitiveness, scientific research competitiveness, student competitiveness and management competitiveness we has established. the indicator system of the university core competence evaluation .The constitute of the specific evaluation indicators is as follows:

(1) Subject competitiveness evaluation index (U_1). It includes three sub-indices such as the strategic position of subjects (V_{11}), Academic echelon (V_{12}) and teaching quality (V_{13})

(2) Scientific research competitiveness evaluation index (U_2). It includes funds for scientific research (V_{21}), undertaken scientific research project (V_{22}), published monographs and articles published (V_{23}), scientific research awards and its transformation conditions (V_{24}) the four sub-indices.

(3) Student competitiveness index (U_3). It includes the enrollment or matriculation rate (V_{31}), student's scale and specification (V_{32}), student's overall quality (V_{33}), student's practice innovation ability (V_{34}), graduate's employment rat (V_{35}), graduate's prestige and social satisfaction degree (V_{36}) the six sub-indicators.

(4) Management competitiveness assessment index (U_4). It includes strategic planning and strategic

management capacity (V_{41}), resource access and use capacity (V_{42}), human resource management capacity (V_{43}), campus cultural reconstruction (V_{44}) the four sub-indices.

3 Grey Cluster Evaluation Model of University Core Competence

In this paper a comprehensive evaluation to the core competitiveness of university has been conducted by using grey fixed weight cluster evaluation method based on triangle whitening weight function in the gray system theory. In view of the different evaluation of many different experts on multi indicators, gray cluster evaluating law can reflects the overall state of university core competitiveness with a more realistic by constructing the index sample matrix, establishing whitening weight function and determining gray cluster appraisal coefficient at its integration. Adopting fixed weight methods may resolve the problems resulting from significance difference, dimension difference and quantity disparate of the indicators. Here is the introduction of grey cluster assessment method

3.1 Determination of the index set and its weight set

Different evaluation indicators have different influence degree on the overall goal of evaluation. So analytic hierarchy principle can be applied to calculate the relative weight of each index in order to weigh and compare the degree of difference of the role of different evaluating indicator on general objective

Suppose the first-level target U_i has m item (i=1,2,…, m), its weight vector for $\eta = (\eta_1, \eta_2, \ldots \eta_m)$. N_i sub-indicators have also been set under the first-level indicator V_{ij} (j = 1,2, ..., ni), the relative weight vector of Index V_{ij} relative to Index Ui is as follows: $w_i = (w_{i1}, w_{i2}, \cdots, w_{in_i})$。

3.2 Evaluation criteria set

After indicator is established, grading standard is needed It is the grading rank of weighing appraisal indicator fit or unfit. As far as the qualitative indicators are concerned，there are different ways of description on its grade. In this paper, the number of evaluation grades is 5 (g = 5), such as “teaching quality t” evaluating indicator being divided into 5 sub-rating level： “very good”、“ good”、“general”、“ poor”、“ very poor”. On quantitative indicators, different figures are used to measure different evaluating levels, such as appraisal score of each evaluating levels from good to bad respectively being as follows:5 points, 4 points, 3 points, 2 points and 1 point ,the score values between adjacent grade taking average score between its grading standard.

3.3 Establishment of evaluation value matrix

Suppose P expresses the rating experts, there are P group of experts participating in the evaluation. As far as the first level indicator U_i is concerned , making x_{ij}^p (i = 1,, ..., m; j = 1,2, ..., ni; p = 1,2, ..., P) for rating sample values given by the P group of experts for evaluation $V_{ij.}$, The value of these samples constitutes the following evaluation value matrix:

$$X_i = \begin{bmatrix} x_{i1}^1 & x_{i1}^2 & \cdots & x_{i1}^p \\ x_{i2}^1 & x_{i2}^2 & \cdots & x_{i2}^p \\ \cdots & \cdots & \cdots & \cdots \\ x_{in_i}^1 & x_{in_i}^2 & \cdots & x_{in_i}^p \end{bmatrix}$$

3.4 Establishment of Evaluation Whitening Weight Function

Carrying out grey cluster assessment needs to determine assessment gray category (reviews rating). If take 5 levels such as “very good, good, normal, poor, very poor” , then the number of evaluation grades g = 5.The threshold of different grey category e measured with digital x_e such as take $x_1 = 5$, $x_2 = 4$, $x_3 = 3$, $x_4 = 2$, $x_5 = 1$, respectively expressed rating standard value of the 5-level and so on. Suppose grey category grade expresses with e, e = 1,2, ..., g, the corresponding number of gray and its whitening weight function may be described as follows:

(1) The first gray type (e = 1) indicates “the best”. Set grey number $\otimes_1 \in [x_1, \infty)$，its whitening weight function is as follows： $f_1(x_{ij}) = \frac{x_{ij}}{x_1}$， $x_{ij} \in [0, x_1)$; $f_1(x_{ij}) = 1, x_{ij} \in [x_1, \infty)$; $f_1(x_{ij}) = 0$, $x_{ij} \notin [0, \infty)$. （1）

(2) Intermediate gray type (e = 2,3, ..., g-1). The grey number $\otimes_e \in [0, x_e, 2x_e]$,its whitening weight function is as follows： $f_e(x_{ij}) = \frac{x_{ij}}{x_e}$， $x_{ij} \in [0, x_e]$; $f_e(x_{ij}) = \frac{2x_e - x_{ij}}{x_e}$, $x_{ij} \in [x_e, 2x_e]$; $f_e(x_{ij}) = 0$, $x_{ij} \notin [0, 2x_e]$. （2）

(3) G Grey type (e = g)indicates "the worst" The grey number $\otimes_g \in [0,2x_g]$,its whitening weight function is as follows: $f_g(x_{ij})=1$, $x_{ij}\in[0,x_g]$; $f_g(x_{ij})=\frac{2x_g-x_{ij}}{x_g}$, $x_{ij}\in[x_g,2x_g]$; $f_g(x_{ij})=0$, $x_{ij}\notin[0,2x_g]$。（3）

3.5 Calculation of coefficient matrix of gray evaluation

Described by the former, x_{ij}^p indicates the sample values of evaluation given by evaluator P for the evaluating indicator V_{ij}. $f_e(x_{ij})$ is the whitening weight function of indicator V_i grey type e, W_{ij} is the weight of indicator V_{ij}, then : $\sigma_{ij}^e=\frac{1}{p}\sum_{p=1}^{p} f_e(x_{ij}^p)$ （4）

It Is called the grey evaluation coefficient of indicator V_{ij} belonged to grey type e. $\sigma_{ij}=(\sigma_{ij}^1,\sigma_{ij}^2,\cdots,\sigma_{ij}^g)$ It is called the coefficient vector of grey evaluation of the index $V_{ij.}$

$$R_i=\begin{bmatrix}\sigma_{i1}^1 & \sigma_{i1}^2 & \cdots & \sigma_{i1}^g\\ \sigma_{i2}^1 & \sigma_{i2}^2 & \cdots & \sigma_{i2}^g\\ \cdots & \cdots & \cdots & \cdots\\ \sigma_{in_i}^1 & \sigma_{in_i}^2 & \cdots & \sigma_{in_i}^g\end{bmatrix}$$ It is called the grey evaluation coefficient matrix of the index U_i.

3.6 Grey cluster evaluation

The comprehensive balance has been carried out by using the relative weight vector $w_i=(w_{i1},w_{i2},\cdots,w_{in_i})$ of the sub-index V_{ij} relative to indicator Ui to get the grey cluster coefficient of the first level indicator U_i belonged to grey category e as follows: $\sigma_i^e=\sum_{j=1}^{n_i} w_{ij}\cdot\sigma_{ij}^e$

the grey cluster coefficient vector of the first level indicators U_i has been obtained by the same way as above: $\sigma_i=(\sigma_i^1,\sigma_i^2,\cdots,\sigma_i^g)$,

The gray cluster coefficient vector of each first level index constitutes gray cluster matrix R^*; then its comprehensive balance has been conducted by using the weight vector $\eta=(\eta_1,\eta_2,\cdots,\eta_m)$ of U_i indicators, in the end a comprehensive clustering results is obtained as follows: $\sigma^e=\sum_{i=1}^{m}\eta_i\cdot\sigma_i^e$

Similarly, the comprehensive clustering results vector can be integrated as follows $\sigma=(\sigma^1,\sigma^2,\cdots,\sigma^g)$。

According to grey clustering coefficient vector σ_i of first level indicator U_i and integrated clustering result vector σ, in accordance with the principle of maximum proximity the attached evaluating rank is determined. If $\sigma_i^e=\max_{1\le e\le g}\{\sigma_i^e\}$ or $\sigma^e=\max_{1\le e\le g}\{\sigma^e\}$ then it belongs to grey category k^*.

4 Application of University Core Competitiveness Grey Cluster Assessment Model

For the determination of the indicator system weights in this article, after having integrated the views of experts we complete it by using the Delphi method (Delphi method) and Analytic Hierarchy Process (AHP). Space is limited so there is no specific description index weight calculation. Ultimately determined the weight of each indicator is as follows:

$\eta=(0.15,0.30,0.45,0.10)$;

$w_1=(0.30,0.30,0.40)$;

$w_2=(0.30,0.30,0.20,0.20)$;

$w_3=(0.20,0.05,0.30,0.10,0.15,0.20)$;

$w_4=(0.20,0.30,0.20,0.30)$。

The Core Competence of a university was investigated and five requested experts carried on grading to each evaluation indicator of core competitiveness. Due to limited space, here does not list in details. Only taking the discipline competitiveness first-level indicator as the example, lists appraisal value matrix X1 constituted by 3 secondary indicators of first-level target discipline competitiveness U1.The arrangement has been as follows:

$$X_1 = \begin{bmatrix} 4 & 3 & 3 & 3 & 4 \\ 3 & 3 & 4 & 4 & 3 \\ 3 & 2 & 3 & 2 & 3 \end{bmatrix}$$

The grey cluster computation is conducted through appraisal value matrix X_1. For example, on "academic strategic position" the target constitution first considers the first grey category(e = 1). Then the score values given by the five experts are put into the formula (1) and (4), and calculates gray clustering coefficient of grey category 1 = 0.68. Similarly, the gray clustering coefficient (e = 2, 3, 4, 5) of other grey category 2,3,4,5 may be calculated. They respectively are $\sigma_{11}^2 = 0.85$, $\sigma_{11}^3 = 0.87$, $\sigma_{11}^4 = 0.30$, $\sigma_{11}^5 = 0$.So the gray clustering coefficient vector of "strategic position of subject "is obtained as follows: σ_{11}= (0.68, 0.85, 0.87, 0.30, 0)

With the same calculation process as above calculate the gray clustering coefficient vector of "academic echelon" and "teaching quality" belonged to the U_1. Then, the grey clustering coefficient matrix of U_1 is obtained by integrating them:

$$R_1 = \begin{bmatrix} 0.68 & 0.85 & 0.87 & 0.30 & 0 \\ 0.68 & 0.85 & 0.87 & 0.30 & 0 \\ 0.52 & 0.65 & 0.87 & 0.70 & 0 \end{bmatrix}$$

with weight vector w_1= (0.30,0.30,0.40)of the first level indicator of U_1 weigh, get the gray clustering result vectors σ_1 = (0.62,0.77,0.87,0.46,0).

With the same way above get the grey clustering result vector of the other three first-level indicators which form the gray clustering results matrix as follows:

$$R^* = \begin{bmatrix} 0.62 & 0.77 & 0.87 & 0.46 & 0 \\ 0.85 & 0.74 & 0.58 & 0.30 & 0 \\ 0.54 & 0.62 & 0.84 & 0.72 & 0 \\ 0.22 & 0.40 & 0.68 & 0.80 & 0.35 \end{bmatrix}$$

With the weight vector η= (0.15, 0.30, 0.45, 0.10) of the first-level indicators weigh and get the comprehensive index system gray clustering result vector σ = (0.61,0.66,0.75,0.56,0.04). According to $\max\{\sigma\} = 0.75$,it can be seen from this that evaluation result belongs to the third-gray category. Namely the comprehensive level of the University Core Competitiveness is general and still needs to continue to improve and enhance.

5 Conclusion

Making an evaluation of the core competence of university is to examine its influence on the survival and development of university from the angle of university strategic objectives. As one kind of attempt, in this article the discussion to the comprehensive evaluation of the university core competitiveness has been made by using grey cluster method. On the one hand the present situation of the university core competitiveness thoroughly has been examined and compared with the university development goals, the questions existing in the core competitiveness cultivation process has been discovered. On the other hand, the experience and lessons in the process of the core competitive cultivation have been summed up , combined with the new reality ,according to facing the new environment and new tasks，the university may re-determine the direction of development of core competencies. This article has provided a new method for the university to conduct an objective assessment of core competencies and the evaluation system of university core competence will be improved further.

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