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A Measurement and Analysis Model of the Human Resource Management Capability Based on the Ideal Domain for Grey Correlation

Xianmin Wei

School of Computer Engineering, Weifang University
5147 Eastern Dongfeng Street, Weifang 261061, China
wfxyweixm@126.com

Abstract

This paper aims at solving existing problems in enterprise human resource management through measurement and analysis of enterprise human resource management capability. It proposes a measurement model for human resource management capability based on ideal domain of grey correlation. First, an improved measurement and analysis system for enterprise human resource management capability is proposed; then, positive and negative ideal domains for enterprise human resource management capability are constructed, and the management capability is measured and analyzed based on grey correlation analysis method to obtain the grey correlation coefficients and grey correlation degrees between the object-under-examination and positive and negative ideal domains respectively. Next, on the basis of comprehensive grey correlation, a human resource management capability model is proposed to measure human resource management capability. Finally, case study is carried out to examine the feasibility of the proposed model.

Keywords: *Human resource management; grey associative analysis; ideal domain; management capability; multiple attribute decision-making models*

1. Introduction

Human resource management is crucial for the development of the enterprise. It is recognized as a key driver to increase competitiveness and maintain sustainability [1-3]. Thus, enterprises should give high priority to human resource management, constantly update management ideas, and introduce a management mechanism in order to improve relevant capability and keep up with new ideas [4-5]. Scholars and experts from enterprises, higher educations and research institutions have dedicated themselves to the study of enterprise human resource management capability and have contributed constructive ideas, strategies and research findings [6-10].

However, previous researches have the following problems. First, researchers tend to analyze enterprise human resource management capability in different lights, without a unified standard of measurement and evaluation; additionally, with insufficient information, the measurement and analysis of management capability lacks credibility. Second, enterprises of different types have different development levels, and often with unclear management goals, which would also undercut the credibility, objectivity, reasonability and scientific nature of the measurement and analysis. Besides, the measurement and analysis model analyzes enterprise management capacity from the perspective of single-ideal domain, but fails to consider the integrity and completeness of measurement information. Therefore, this paper proposes an improved measurement and analysis system for enterprise human resource management capability and establishes the measurement and analysis model of multiple ideal domains based on grey correlation analysis [11-15].

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2. The Measurement and Analysis System for Human Resource Management Capability

Guided by scientific principle, objective principle and practical principle, this paper analyzes the human resource management capability from five perspectives, namely basic qualities of managers, talent training, system planning, enterprise development and human resource management. The measurement and analysis system for human resource management capability is constructed, as shown in Table 1.

Table 1. The Measurement and Analysis System for Human Resource Management Capability

System layer	Criteria layer	Index layer
The measurement and analysis system for human resource management capability U	Basic qualities of managers U_1	Working attitude u_{11}
		Management capability u_{12}
		Capability of innovation and creativity u_{13}
		Capability of business planning u_{14}
		Leadership u_{15}
	Talent training U_2	Ratio of introducing professional and technical people u_{21}
		Ratio of losing professional and technical people u_{22}
		Capability of team building u_{23}
		Capability of employee training u_{24}
		Rationality of recruitment u_{25}
		Cost of talent training u_{26}
	System planning U_3	Rationality of organization u_{31}
		Rationality of job division u_{32}
		Rationality of incentives u_{33}
		Rationality of the salary system u_{34}
		Information sharing degree u_{35}
		Capability of enterprise investment u_{36}
	Enterprise development U_4	Capability to implement enterprise development strategy u_{41}
		Capability of market analysis u_{42}
		Capability to maintain and popularize business brands u_{43}
		Capability to improve working environment u_{44}
		Marketing capability u_{45}
		Profit rate u_{46}
	Human resource management	Rationality of personnel assessment u_{51}

	U_5	Rationality of performance structure u_{52}
		Business culture u_{53}
		Employee satisfaction u_{54}
		Capability of human resource planning u_{55}

3. The Measurement and Analysis System for Human Resource Management Capability based on Ideal Domain of Grey Correlation

3.1. Scheme Set and Indicator Set

Enterprises vary from each other in human resource management capability. As a result, there is tailored measurement scheme for each enterprise. For m enterprises selected for measurement, each has a scheme set:

$$C = \{C_1, \cdots, C_i, \cdots, C_m\} \tag{1}$$

Based on the measurement and analysis system, there are two layers of indicator sets:

$$U_5 = \{U_1, U_2, U_3, U_4, U_5\} \tag{2}$$

$$\begin{cases} U_1 = \{u_{11}, u_{12}, u_{13}, u_{14}, u_{15}\} \\ U_5 = \{u_{21}, u_{22}, u_{23}, u_{24}, u_{25}, u_{26}\} \\ U_5 = \{u_{31}, u_{32}, u_{33}, u_{34}, u_{35}, u_{36}\} \\ U_5 = \{u_{41}, u_{42}, u_{43}, u_{44}, u_{45}, u_{46}\} \\ U_5 = \{u_{51}, u_{52}, u_{53}, u_{54}, u_{55}\} \end{cases} \tag{3}$$

3.2. Standardization of Indicators

Qualitative indicators of human resource management capability are usually described in fuzzy language. To better conduct the grey correlation analysis, this paper adopts a 0-1 scale of five grades to describe qualitative indicators. Descriptions and definition are shown in Table 2.

Table 2. Description of Qualitative Indicators

Value of quantity of indicators	Qualitative description	Definition
0.2	Undesirable	Far from the ideal goal
0.4	Poor	Not close to the ideal goal
0.6	Mediocre	Close to the ideal goal
0.8	Good	Very close to the ideal goal
1.0	Excellent	Exactly the ideal goal
0.1,0.3,0.5,0.7,0.9	In between	In between

These qualitative indicators are either point value or interval value with definite ranges. To facilitate analysis, these values should be standardized. Suppose:

There are m schemes in the scheme set, and indicator j is a positive indicator has a point value $r(u_{ij})$, and then the standardized value of quantity of indicator j is:

$$v(u_{ij}) = \frac{r(u_{ij})}{max(r(u_{ij}))|1 \le i \le m} \tag{4}$$

Indicator j is a negative indicator and has point value $r(u_{ij})$, and then the standardized value of quantity of indicator j is:

$$v(u_{ij}) = \frac{min(r(u_{ij}))|1 \le i \le m}{r(u_{ij})} \tag{5}$$

Indicator j is a positive indicator and if it has interval value $r(u_{ij}) = [r^a(u_{ij}), r^b(u_{ij})]$, then the standardized value of quantity of indicator j is:

$$v(u_{ij}) = [v^a(u_{ij}), v^b(u_{ij})] = \left[\frac{r^a(u_{ij})}{max(r^b(u_{ij}))|1 \le i \le m}, \frac{r^b(u_{ij})}{max(r^b(u_{ij}))|1 \le i \le m}\right] \tag{6}$$

Indicator j is a negative indicator and if it has interval value $r(u_{ij}) = [r^a(u_{ij}), r^b(u_{ij})]$, then the standardized value of quantity of indicator j is:

$$v(u_{ij}) = [v^a(u_{ij}), v^b(u_{ij})] = \left[\frac{min(r^a(u_{ij}))|1 \le i \le m}{r^b(u_{ij})}, \frac{min(r^a(u_{ij}))|1 \le i \le m}{r^a(u_{ij})}\right] \tag{7}$$

After standardization, we can see the standardized value of quantity of both qualitative indicators and quantitative indicators fall between 0-1. In other word, these indicators are under a unified measurement standard and the differences between indicators are wiped out.

3.3. Weight of Indicators

The importance of indicators varies from each other. Thus, they have different weights. This paper adopts a comprehensive evaluation method to assign weight to each indicator. If there are p experts to score and q indicators for measurement, we take the 1-9 scale to assign weight and obtain the initial judgment matrix $\boldsymbol{A}$.

$$\boldsymbol{A} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1q} \\ a_{21} & a_{22} & \cdots & a_{2q} \\ \vdots & \vdots & \vdots & \vdots \\ a_{p1} & a_{p2} & \cdots & a_{pq} \end{bmatrix} \tag{8}$$

The weight w_t of indicator t is:

$$w_t = \frac{\sum_{s=1}^{p} a_{st}}{\sum_{t=1}^{q} \sum_{s=1}^{p} a_{st}} \tag{9}$$

3.4. Grey Correlation Ideal Domain and Grey Correlation Analysis

Grey correlation analysis is used to analyze geometric similarities of sequence. It is an effective method for multiple attribute decision-makings. After standardization of indicators, we can get the grey ideal domain. If indicator j is a positive indicator and has point value, then the grey positive ideal domain $v_j^{\square\square}$ is:

$$v_j^{\square\square} = max\left(v\left(u_{ij}\right)\right) | 1 \le i \le m \tag{10}$$

Indicator j is a negative indicator and has point value, and then the grey negative ideal domain $v_j^{\nabla\square}$ is:

$$v_j^{\nabla\square} = min\left(v\left(u_{ij}\right)\right) | 1 \le i \le m \tag{11}$$

Indicator j is a positive indicator and has interval value, and then the grey positive ideal domain $v_j^{\square\square}$ is:

$$v_j^{\square\square} = \left[max\left(v^a\left(u_{ij}\right)\right) | 1 \le i \le m, max\left(v^b\left(u_{ij}\right)\right) | 1 \le i \le m \right] \tag{12}$$

Indicator j is a negative indicator and has interval value, then the grey negative ideal domain $v_j^{\square\square}$ is:

$$v_j^{\nabla\square} = \left[min\left(v^a\left(u_{ij}\right)\right) | 1 \le i \le m, min\left(v^b\left(u_{ij}\right)\right) | 1 \le i \le m \right] \tag{13}$$

The correlation coefficient $\eta_{ij}^{\square\square}$ between the i-th scheme and the grey positive ideal domain of indicator j is:

$$\eta_{ij}^{\square\square} = \frac{\min_{1 \le i \le m} \min_{1 \le j \le n} \left| v_j^{\square\square} - v\left(u_{ij}\right) \right| + \frac{1}{2} \max_{1 \le i \le m} \max_{1 \le j \le n} \left| v_j^{\square\square} - v\left(u_{ij}\right) \right|}{\left| v_j^{\square\square} - v\left(u_{ij}\right) \right| + \frac{1}{2} \max_{1 \le i \le m} \max_{1 \le j \le n} \left| v_j^{\square\square} - v\left(u_{ij}\right) \right|} \tag{14}$$

In particular, when the indicator j has interval value, Eq. (14) is expressed as:

$$\eta_{ij}^{\square\square} = \frac{\min_{1\le i\le m}\min_{1\le j\le n}\left|\lambda_{ij}^{\square\square}\right| + \frac{1}{2}\max_{1\le i\le m}\max_{1\le j\le n}\left|\lambda_{ij}^{\square\square}\right|}{\left|\lambda_{ij}^{\square\square}\right| + \frac{1}{2}\max_{1\le i\le m}\max_{1\le j\le n}\left|\lambda_{ij}^{\square\square}\right|} \tag{15}$$

Where:

$$\lambda_{ij}^{\square\square} = \frac{\max\left(v^{a}\left(u_{ij}\right)\right) + \max\left(v^{b}\left(u_{ij}\right)\right)}{2} - \frac{v^{a}\left(u_{ij}\right) + v^{b}\left(u_{ij}\right)}{2} \tag{16}$$

The correlation coefficient $\eta_{ij}^{\nabla\square}$ between the i-th scheme and the grey negative ideal domain of indicator j is:

$$\eta_{ij}^{\nabla\square} = \frac{\min_{1\le i\le m}\min_{1\le j\le n}\left|v_{j}^{\nabla\square} - v\left(u_{ij}\right)\right| + \frac{1}{2}\max_{1\le i\le m}\max_{1\le j\le n}\left|v_{j}^{\nabla\square} - v\left(u_{ij}\right)\right|}{\left|v_{j}^{\nabla\square} - v\left(u_{ij}\right)\right| + \frac{1}{2}\max_{1\le i\le m}\max_{1\le j\le n}\left|v_{j}^{\nabla\square} - v\left(u_{ij}\right)\right|} \tag{17}$$

In particular, when the indicator j has interval value, Eq. (17) is expressed as:

$$\eta_{ij}^{\nabla\square} = \frac{\min_{1\le i\le m}\min_{1\le j\le n}\left|\lambda_{ij}^{\nabla\square}\right| + \frac{1}{2}\max_{1\le i\le m}\max_{1\le j\le n}\left|\lambda_{ij}^{\nabla\square}\right|}{\left|\lambda_{ij}^{\nabla\square}\right| + \frac{1}{2}\max_{1\le i\le m}\max_{1\le j\le n}\left|\lambda_{ij}^{\nabla\square}\right|} \tag{18}$$

Where:

$$\lambda_{ij}^{\nabla\square} = \frac{\min\left(v^{a}\left(u_{ij}\right)\right) + \min\left(v^{b}\left(u_{ij}\right)\right)}{2} - \frac{v^{a}\left(u_{ij}\right) + v^{b}\left(u_{ij}\right)}{2} \tag{19}$$

3.5. Implementation of the Measurement and Analysis System for Human Resource Management Capability based on Ideal Domain of Grey Correlation

Given that different indicators have different weight, the weighed correlation $\delta_{i}^{\square\square}$ between the i-th scheme and the grey positive ideal domain of indicator j is:

$$\delta_{i}^{\square\square} = \sum_{j=1}^{n}\left(w_{ij} * \eta_{ij}^{\square\square}\right) \tag{20}$$

The weighed correlation $\delta_{i}^{\nabla\square}$ between the i-th scheme and the grey negative ideal domain of indicator j is:

$$\delta_{i}^{\nabla\square} = \sum_{j=1}^{n}\left(w_{ij} * \eta_{ij}^{\nabla\square}\right) \tag{21}$$

Thus, the comprehensive weighted grey correlation $\delta_i^{\square}$ is:

$$\delta_i^{\square} = \frac{1}{1 + \left(\frac{\delta_i^{\nabla\square}}{\delta_i^{\square\square}} \right)^2} \tag{22}$$

According to closeness principle, if there is:

$$\delta_k^{\square} = \max\left\{ \delta_1^{\square}, \delta_2^{\square}, \cdots, \delta_m^{\square} \right\} \tag{23}$$

Then scheme k has the best human resource management capability.

4. Measurement and Analysis of Human Resource Management Capability of the Enterprise

Start-up high-tech enterprise may have some defects in human resource management as it is in the early stage of development. Human resource management capability is usually crucial for its development. Thus, this paper takes high-tech enterprises in a national-level industrial park as case in example to test the proposed model by studying its human resource management capability. The measurement and analysis of human resource management capability of this enterprise is shown in Table 3.

Table 3. Measurement and Analysis of Human Resource Management Capability of the Enterprise

Criteria layer	Index layer	Enterprise data		
		HGD	TJM	JEH
U_1	u_{11}	0.95	0.90	0.95

Construct the grey positive ideal domain and grey negative ideal domain. Calculate grey correlation and obtain the grey correlation coefficient of different indicators about the enterprises, as shown in Table 4 and 5.

Table 4. Correlation Coefficient of Grey Positive Ideal Domain

Criteria layer	Index layer	Enterprise data		
		HGD	TJM	JEH

Table5. Correlation Coefficient of Grey Negative Ideal Domain

Criteria layer	Index layer	Enterprise data		
		HGD	TJM	JEH

Thus, we can obtain the grey correlation and the comprehensive weighted grey correlation, as shown in Table 6.

Table 6. Grey Correlation of Human Resource Management Capability

	Weight	HGD		TJM		JEH	
		Positive ideal domain	Negative ideal domain	Positive ideal domain	Negative ideal domain	Positive ideal domain	Negative ideal domain
Comprehensive weighted grey correlation		0.624		0.482		0.411	

From the abovementioned analysis, we can see that HGD in the industrial park has good human resource management capability while TJM and JEH need to improve their human resource management capability in order to keep competitiveness and sustainability.

5. Conclusion

To solve problems existing in human resource management and enhance the management capability of the enterprise, this paper proposes a measurement and analysis system for human resource management capability based on ideal domain of grey correlation. It constructs the system following the scientific principle, the objective principle and the practical principle and obtains grey positive ideal domain and grey negative ideal domain of indicators. With the weight of indicators considered, it establishes a comprehensive weighted grey correlation model based on ideal domains and successfully measures the human resource management capability. This model proposed in this paper serves as a theoretical support for enhancing competitiveness and maintain sustainability of the enterprise. The model is clear in its physical definition following a scientific theory and takes a new perspective, namely multiple ideal domains to analyze the human resource management capability. More importantly, it has high credibility and is easy to operate on the computer.

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Author

Xianmin Wei, he received the M. Sc. degree in computer applications from Shandong Science and Technology University (2005). He is currently an associate professor in school of computer engineering at Weifang University, China. He has published over 30 papers and 3 books in professional fields. Since 2011, he has been a member of IEEE-CS, ACM and CCCF, respectively. His fields of research are focused on swarm intelligent, intelligent sensor networks.