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Construction of Talent Quality Evaluation Index System in Hydropower Industry Under the Background of Digital Transformation

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Abstract

Digital transformation and upgrading pose new requirements for talent quality. Taking human resources positions as an example, this article constructs a "3+X" talent quality evaluation index system that includes knowledge, ability, attitude, and professional skills. Based on the data characteristics of 55 employees in human resources positions, a combination weighting model, entropy method, and BP neural network model are used, and an evaluation index system and weight evaluation index system suitable for the quality characteristics of talents in China's hydropower industry have been constructed. The research results show that employee competence is an important indicator for driving digital transformation, with knowledge and professional skills playing a relatively central role, and attitudes being less differentiated. Finally, the research significance and shortcomings of the study are summarized, and the prospects for future development are provided.

Keywords: Digital transformation; Talent quality characteristics; Evaluation index; BP neural network; Entropy method

Introduction

In recent years, the digital economy has had a profound impact and transformation on resource allocation, economic form, and competition rules globally, playing a core role in promoting global development [1-3]. The Party and government repeatedly emphasize the need to "accelerate the development of the digital economy, promote the deep integration of the digital economy and the real economy, and create a digital industry cluster with international competitiveness." The rapid development of the digital economy has also brought new opportunities and challenges to traditional industries [4]. This is the case not only in China, but also around the world [5].

In the wave of digital economy transformation, talents with digital knowledge are indispensable [6, 7]. The construction of a talent evaluation system is undoubtedly a crucial issue [8-10]. At present, China's power enterprises are facing an important stage of institutional reform, especially with the arrival of the era of big data and artificial intelligence [11]. The traditional talent evaluation system in the hydropower industry is no longer sufficient to support enterprises in adapting to changes in the economic environment and cannot accurately describe their employment needs [12, 13]. According to the decision and deployment of the Party Central Committee and the State Council on the three-year action of state-owned enterprise reform and the work requirements of the Country owned Assets Supervision and Administration Commission, as well as the comprehensive implementation of the "Implementation Opinions on Deepening the Three System Reform of the National Energy Group" (National Energy Organization [2021] No. 176), in order to adapt to the requirements of the group company's reform and development and create world-class demonstration enterprises, and in combination with the characteristics of the new era represented by the digital economy, establish a scientific and focused hydropower industry A reasonable job talent evaluation system is a vital issue for Daduhe Company to maintain stability and long-term development.

In response to the above matters, this paper takes the human resources positions in Guoneng Daduhe Company as the research object, uses SPOT team guidance technology to jointly create an evaluation index system for the talent quality characteristics of human resources positions, and then uses entropy method and BP neural network to explore the index weights, constructing an evaluation index system suitable for the talent quality of the hydropower industry [14, 15].

Research Methods and Evaluation Indicator System Construction

SPOT Team Guidance Technology

From the perspective of origin, SPOT team leadership technology is a team participatory decision-making method developed by Parab Naidu et al. (2014) [16]. It is guided by four elements: space, process, outcome, and time. Within a given time, team members engage in team interaction to achieve value co creation of a certain task.

In the actual operation process, the SPOT team guidance technology follows the 4D rule as the standard, communicates and interacts with team members through visual signage, and finally forms team members' identification with a certain goal through continuous correction and discussion.

Evaluation Index System for Talent Quality Characteristics in the Hydropower Industry

The construction of the evaluation system for the quality of talents in the hydropower industry should start from the evaluation dimension of quality characteristics, in order to find a way to construct the indicator system.

The Evaluation Dimension and Construction of Talent Quality Characteristics

Construction refers to the concepts formed through the understanding, expectation, evaluation, and thinking of people, things, and things in the environment. Based on SPOT team guidance technology, this article recruited more than 30 members specializing in human resource management from 25 subsidiaries of Guoneng Daduhe Group to participate in the seminar. According to Li Yang and Pan Haisheng, digital ability refers to the collective term for the knowledge, abilities, attitudes, and other skills that people must possess to integrate into the digital society [17].

In 2016, the European Union mentioned in the "Council Recommendation on Key Competences for Lifelong Learning" that digital capability is a survival capability formed by focusing on communication technology, utilizing internet communication and information governance [18]. In the EU Citizen Quality and Literacy Framework (DigComp2.1), citizens' quality and literacy are divided into four levels [19]. Considering the social attributes of human resource management positions, in the team guidance process, the three elements of "knowledge, ability, and attitude" are considered as the "universal qualities" of talent quality characteristics and set as the criterion layer. At the same time, due to the professionalism of human resources positions, "professional skills" are regarded as the professional qualities of human resources positions and added to the criteria layer, forming a "3+X" talent quality characteristic evaluation dimension [20].

Construction of Evaluation Index System for Talent Quality Characteristics in the Hydropower Industry

As an important functional position in enterprises, human resource management positions play a momentous role in human resource planning, personnel recruitment, personnel selection, motivation, and assessment. In order to improve the efficiency of personnel utilization in enterprises, human resource positions exhibit professional characteristics; On the other hand, in the context of digital empowerment of traditional enterprise transformation and upgrading, enterprise human resource management needs to use information systems and tools to improve work efficiency. Therefore, the job characteristics of human resources show a trend of digitization. Therefore, based on domestic and foreign literature research and SPOT team guidance, this article combines the actual situation of Daduhe Group to construct a total of 15 evaluation indicators related to the quality characteristics of talent in human resources positions, as shown in Figure 1.

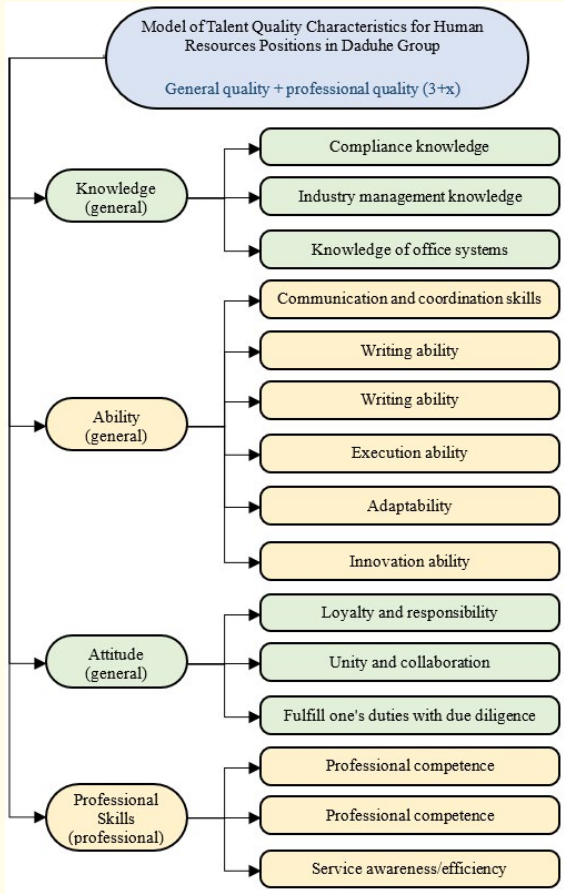

Figure 1: Evaluation Model for Talent Quality Characteristics of Human Resources Positions.

Determination of the Weight of Evaluation Indicators for Talent Quality Characteristics

The applicability and accuracy of the evaluation model for the quality characteristics of job talents depend on the determination of weight indicators. 55 employees are selected in human resources positions within Guoneng Daduhe Group as the research object; In order to avoid data errors caused by subjective and objective scoring methods as much as possible, this article constructs a combination weighting model based on entropy method and principal component analysis method; Finally, by calculating the weights of

each indicator, countermeasures and suggestions are provided for the digital transformation, upgrading, and management practices of enterprises.

Entropy Method

Entropy method is an approach of evaluating the orderliness of system elements, which can largely avoid the impact of subjective scoring methods such as Analytic Hierarchy Process (AHP) on system results. This research processes the data as follows:

Step 1: Define the dataset. Assumption: In the talent quality characteristic evaluation model, there are a total of i(i=1,...,38) scoring factors and j(j=1,...,55) employee data. So, dataset Y_{ij} can be expressed as:

$$Y_{ij} = \begin{bmatrix} y_{11} & \cdots & y_{1j} \\ \cdots & \cdots & \cdots \\ y_{i1} & \cdots & y_{ij} \end{bmatrix} \quad (1)$$

Step 2: Data processing. Due to the different calculation units and statistical methods used in the original data. To eliminate the impact of different dimensions on the evaluation results, this article processes the original as follows:

$$y'_{ij,\text{Positive indicators}} = \frac{y_{ij} - \min\{y_{ij}\}}{\max\{y_{ij}\} - \min\{y_{ij}\}} \quad (2)$$

$$y'_{ij,\text{Negative indicator}} = \frac{\max\{y_{ij}\} - y_{ij}}{\max\{y_{ij}\} - \min\{y_{ij}\}} \quad (3)$$

Step 3: Calculate information weights. The paper assumes that the value range of information entropy e_j is [0,1]. Meanwhile, the information weight of the i-th scoring factor is expressed as w_j. So, the weight of factor i in the indicator system can be expressed as:

$$w_i = \frac{1 - e_i}{\sum_{i=1}^{n}(1 - e_i)} \quad (4)$$

wherein $e_i = -\ln m \times \sum \frac{y'_{ij}}{\sum_{i=1}^{n} y'_{ij}} \times ln \frac{y'_{ij}}{\sum_{i=1}^{n} y'_{ij}}$.

Meanwhile, considering that the evaluation index results in formulas (2) and (3) may be taken as 0, and the true value range of the natural logarithm is (0,+∞). Then, it is stipulated that when $y'_{ij} = 0,\ n\frac{y'_{ij}}{\sum_{i=1}^{n} y'_{ij}} = 0.$

BP Neural Network

BP neural network is a model of neural network proposed by Rumelhart in 1986, which is a method of parameter prediction using the sigmoid function. The basic principle is shown in Figure 3. Through data analysis and processing in three stages: input layer, intermediate layer (also known as hidden layer), and output layer, nonlinear data can be effectively predicted and processed.

In a neural network, if there are nnodes in the input layer and m nodes in the output layer, the number of intermediate layers h can be expressed as:

$$h = \sqrt{m + n} + a \quad (5)$$

Among them, a is the adjustment constant, with values ranging from [1, 10].

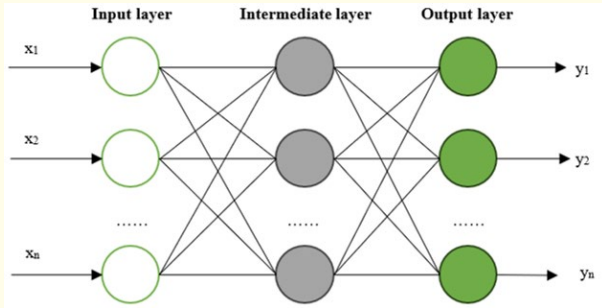

Figure 2: Structure diagram of BP neural network.

In this study, the first $I_{ij}=[I_{1j},I_{2j},I_{3j},\ldots,I_{ij}]^T$ (i ≤ 38) column in dataset Y_{ij} was set as the input matrix, and the remaining columns were set as the output matrix L_i (i≤38). Based on the viewpoints of Sun Jinghao and He Haiyan et al. [15, 21], the observation error $Error_{ij}$ between training result T_{ij} and actual result Y_{ij} can be expressed as:

$$Error_{ij} = \frac{1}{2}\sum(Y_{ij} - T_{ij})^2 \qquad (6)$$

Meanwhile, according to the viewpoint of reference [21], the correction formula for the intermediate layer can be expressed as:

$$\Delta w_{ij}(k) = -\eta \frac{\partial Error_{ij}}{\partial w_{ij}} \qquad (7)$$

If the error between the training results and the actual results meets the threshold, the expected weight can be output. Otherwise, the model training will be repeated until the requirements are met.

Objective Combination Weights

This article calculates the combination weight based on two objective weight calculation methods: entropy method and BP neural network, and the combination weight W_q (q=1,2) can be expressed as:

$$W_q = \sum \lambda_q w_q^T \qquad (8)$$

Among them, $w_q^T (q = 1,2)$ represents the weight coefficient matrix calculated based on entropy method and BP neural network.

Based on the principle of maximizing the difference between the evaluated objects, an objective function can be constructed:

$$W_q = \sum \lambda_q w_q^T y'_{ij} \ \text{ s.t. } \sum \lambda_q = 1 \qquad (9)$$

So, by performing Lagrangian calculations on equation (9), the objective combination weight coefficient matrix λ'_q can be obtained.

Empirical Analysis

Based on the above analysis, an empirical analysis on the data of 55 employees in human resources positions at Guoneng Daduhe Group is conducted. The specific situation is as follows.

Weight Calculation Based on Entropy Method

Based on the actual data situation, two researchers screened the actual data of 55 employees, and then used Matlab R2016b to write a weight algorithm, ultimately obtaining the weight matrix W_1 (see Table 1).

Target layer	*Criterion layer*	*Weight*		
		Entropy method	*BP neural network*	*Combination weight*
Ability (0.397)	communication skills	0.079	0.074	0.076
	Writing ability	0.079	0.082	0.081
	learning ability	0.079	0.073	0.075
	Adaptability	0.080	0.086	0.083
	Innovation ability	0.052	0.059	0.056
	Execution ability	0.026	0.024	0.025

Table 1: Indicator System and Weights of Talent Quality Characteristics Criteria for Human Resources Positions.

Weight Calculation based on BP Neural Network

In the neural network model, the structure of initial data matrix Y_{ij} is 38 × 55. In the parameter setting, the raw data of 55 employees is used as input values. According to the algorithm of BP neural network, the gradient parameter is set to 0.01 in Matlab, and after 50 iterations, the predicted weight result is calculated (see Table 2 for details), with a correlation coefficient of R^2=0.9135.

Calculation of Objective Combination Weights

Target layer	*Factor layer*	*weight*		
		Entropy method		
Ability (0.397)	Communication and collaboration	0.026	0.025	0.026
	Language ability	0.026	0.021	0.023
	Number of organizational meetings	0.026	0.028	0.027
	Official document/system writing	0.026	0.028	0.027
	News promotion	0.027	0.033	0.030
	Paper/monograph	0.026	0.022	0.024
	continuing education	0.027	0.024	0.025
	Professional qualifications	0.026	0.023	0.024
	Internal trainer	0.026	0.025	0.026
	Multiple job experiences	0.027	0.035	0.031
	Physical condition	0.027	0.028	0.027
	Psychological resilience	0.026	0.024	0.025
	Innovation Awards	0.025	0.032	0.029
	intellectual property right	0.027	0.028	0.027
	performance appraisal	0.026	0.024	0.025

Table 2: Index System and Weights of Talent Quality Characteristics Factor Layer for Human Resources Positions.

Based on the calculation results of entropy method and BP neural network, using Matlab to calculate equations (8) and (9), a normalized coefficient matrix λ'_q = (0.4236,0.5764) can be obtained. The weight calculation results are shown in Table 2.

Both Tables 1 and 2 are studied using competency indicators as an example. From these two tables, it can be seen that the weight difference calculated using the three methods is relatively small, indicating that each indicator has a certain degree of stability in evaluating talents in human resource management positions.

Conclusion

Digital transformation has become an inevitable choice for the hydropower industry. It can not only improve the management level and production efficiency of the hydropower industry, but also promote the optimal allocation and utilization of hydropower resources, thereby providing strong support for the construction of ecological civilization, national energy security, and the realization of the "dual carbon" goals. This article takes the human resource management position as an example to construct an evaluation system for talent quality characteristics, achieving theoretical basis, traceable data, and executable operation, laying the foundation for further building a digital management evaluation system.

There are also shortcomings in this article. Firstly, this article only uses 55 employees as an example to calculate weights, which poses problems such as insufficient data and inaccurate calculations. Secondly, digital transformation is interconnected, and this article only completed the construction of talent evaluation index system for human resource management positions. Thirdly, in the digital era, rapid technological progress and ever-changing market demand have led to a shortened applicability of evaluation indicators. In subsequent practice, it is necessary to continuously maintain and update the talent evaluation index system to keep up with the times and ensure the effectiveness of the evaluation.

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