Human Resource Management Model Innovation of Forestry Science and Technology Enterprises in the Era of Big Data

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Abstract:

The competitive advantage based on the practice of human resource management is the key for high-tech forestry enterprises to survive in a highly uncertain environment. This paper studies the innovation of human resource management model of science and technology enterprises in the era of big data. In order to improve the accuracy of human resource cost evaluation, this paper designs a data-driven human resource cost evaluation algorithm. This paper collects the data of human resource cost evaluation, and uses chaos theory to reconstruct the data to restore the characteristics of human resource cost changes. This paper uses extreme learning machine to establish human resource cost evaluation algorithm, and uses particle swarm optimization algorithm to optimize extreme learning machine. Finally, the simulation experiment of human resource cost evaluation is carried out. The results show that the algorithm can reflect the changing characteristics of human resource cost. This method improves the evaluation results of human resource cost and achieves better results than other human resource cost evaluation models. This method provides a theoretical reference for the research of data-driven human resource optimal allocation model and algorithm.

Keywords: *Forestry science and technology enterprises, human resource management, competitive advantage, high-tech enterprises, particle swarm optimization algorithm.*

I. INTRODUCTION

In recent years, the roles and functions of human resource managers have changed

significantly. Its main responsibilities have changed from administrative and logistics work to HR business partner. It can be seen that human resource managers play an important role in organizational change, cultural construction, performance improvement and so on [1-2]. Their role has changed from passive executor to active strategic leader. In view of the special role of human resource management positions, in today's enterprise recruitment, accurate positioning of excellent human resource management personnel is particularly important. Competency model provides effective guidance for solving these problems [3]. It can effectively identify the potential characteristics of individuals, distinguish the excellent and mediocre performance, so as to achieve a reasonable match between positions and employees, namely person post matching. Therefore, the researchers have carried out the research on the competency of human resource management personnel, and achieved certain results.

At the same time, competence is a dynamic concept, not only related to the specific working situation, but also the connotation of which is constantly enriched with the change of the characteristics of the times. The arrival of big data era and the development of network recruitment will inevitably bring forward new requirements for human resource managers [4-5]. The competency model constructed can not fully adapt to the characteristics of the current era. On the other hand, because competency model plays an important role in dynamically achieving the strategic goals of human post organization, it has been widely used in recruitment, employee performance, career management and so on. Based on the above problems, this study focuses on the construction of competency model of human resource management post and the accurate positioning of high-quality talents in the era of big data. It aims to reconstruct the competency model of human resource management post through dynamic mining of recruitment text in order to meet the needs of enterprises [6]. At the same time, the competency model and resume screening are combined by machine learning method to construct the competency position matching model, and the job matching of resume selection is realized from small-scale manual operation to big data machine calculation.

II. RESEARCH SUMMARY

2.1 The concept of competency and its application in management

The concept of competency was first put forward by psychologist white in 1959. He thinks that competency is a new driving force, which can promote the effective interactive learning process between individual and environment. Since then, a number of researchers on this basis from all aspects of the competency for a more in-depth exploration. Harvard University Professor McClelland pointed out in his research in 1973 that competency is a deep-seated feature that can distinguish the high-performance and mediocre in the post. It can be any feature

that distinguishes the excellent and mediocre, such as attitude, values, knowledge, etc. [7].

In the application of competency, scholars at home and abroad have carried out research from recruitment and allocation, performance management, career management and other aspects. In terms of post allocation, since Spencer proposed the competency model related to the position, namely iceberg model, competency model has been widely used in recruitment allocation, providing effective guidance for the ability post matching. Morrison studied the important role of competency model in competency post matching, and specifically discussed the use of competency model in post allocation. Farnham et al. Conducted an internal survey involving managers and training experts in the Social Service Department of West Sussex County Council. Through the research on the survey results, the limitations of traditional recruitment and selection practices were summarized, and competency based recruitment methods were proposed to replace the traditional methods. Among domestic scholars, Ding Xiuling combines competency with job analysis, job application form design, interview and evaluation center technology, and discusses the important role of competency in talent recruitment and selection. Li Yuntao and Liu Yan built the model of enterprise employee competency human cost matching degree, which provides a reference for enterprises to balance the relationship between cost input and employee competency and implement classified management for employees [8-9].

2.2 Construction of competency model for human resource managers

Based on the important role of human resource managers in enterprises, in recent years, scholars at home and abroad have carried out a series of research on their competency model, and achieved important results. Ulrich et al. Collected the data of 12689 human resource professionals from 109 companies and evaluated their competency model extensively. The results show that when human resource professionals demonstrate business knowledge, human resource delivery and change management capabilities, their colleagues will consider their work more effective. On the basis of in-depth interviews with 10 senior human resource managers, Yeung et al. proposed a general human resource competency model, including key competencies related to different industries and specific competencies with differentiation in different roles [10]. Hamid conducted a survey of 380 human resource practitioners in Malaysia's manufacturing and service industries. The empirical results show that business competence is not necessary for human resource managers. Entrepreneurship and business acumen (including entrepreneurial skills, information and communication technology, knowledge management) and basic performance promotion (including creativity, problem solving, decision-making) are important for human resource management practitioners.

Through the above discussion, we can find that behavioral event interview and questionnaire survey are commonly used in the construction of competency model of human resource management posts. However, these methods often cost a lot, which will lead to narrow coverage, can not reflect the needs of enterprises, and will be affected by the cognitive level of the interviewees at that time, and the subjective factors are relatively large. It can be seen that in the above research, due to the different objects and sample size, scholars have a certain consistency in the research of human resource management personnel competency, but there are also contradictory places. In short, a unified view has not been formed. With the advent of big data era and the development of network recruitment, the competency model constructed in the past may not meet the requirements of the new era.

2.3 Research on ability post matching

The theory of competency post matching has always been the focus of human resource management research, and has received continuous attention from scholars at home and abroad. The research of foreign scholars mainly focuses on two aspects: the related model of ability post matching and its role. In the study of competency post matching model, Schneider proposed ASA model, namely attraction selection running in model. He believes that the mutual attraction between people and organizations is due to the similarity between the two. As time goes on, people who are not suitable for the organization will leave, so that the homogeneity of personnel in the organization is increasing day by day, and there is a certain degree of tolerance between people and positions. Kristof integrates the previous views. He believes that when either party in the organization can meet the needs of the other party, or there are some similarities between them in some aspects, the matching between people and organizations can be realized. Judge pointed out that in the process of competency post matching, personality, motivation, values and other characteristics should be considered comprehensively. In this study, Goodman explored the effect of competency post matching on task and contextual performance. It is found that the perception of organizational culture and the differences between employees' ideal organizational culture and actual organizational culture have important effects on the prediction of contextual performance and task performance. Tziner's research shows that competency post fit not only helps to improve organizational performance, but also has a positive impact on individual performance. The employees who match the positions show relatively high performance at work.

Domestic scholars mainly focus on the research of competency post matching method. Jia Tianbing and Liu Sifeng put forward a dynamic person post matching model based on multivariate grey correlation analysis, specifically discussed the method and steps of person post dynamic matching, and verified the effectiveness of the method through a case. Zou

Shuliang and Wu Liangpeng used interval vague set to describe the fuzziness in person post matching, and constructed the evaluation index system of person post matching through the bottom-up reverse index system construction method. Xie Zhihong and Chen Weizheng integrate the three perspectives of human capital, social capital and psychological capital, based on the person post matching theory, use mathematical model to further explore the matching mechanism between various combination types and employees' jobs, and analyze the impact of person post matching results on employees' attitude and behavior.

It can be seen from the above literature that scholars at home and abroad have conducted a more detailed study on the matching of ability and post. However, with the advent of the era of big data and the development of online recruitment, in the face of a large number of job seekers' resumes, the existing theories and methods can not fully meet the requirements of person post matching in the current era.

III. THEORETICAL BASIS

3.1 Ability post matching theory

In the early 20th century, under the background of scientific management theory being proposed and widely recognized, Taylor, Fayol, Weber and others put forward the theory of ability post matching, which aims to maximize the potential of employees and make them make the greatest contribution to the organization. The theory of ability post matching is about the consistency of personality and post nature. The basic idea is: individual differences are common, individuals have unique personality characteristics, each post due to the nature of work, environment, conditions, ways and other differences, the ability of workers, knowledge, skills, character, temperament, psychological quality put forward different requirements. In career decision-making, we should allocate the corresponding post types according to the personality characteristics, that is, to match the ability and post.

Zhang Tongquan, Han Dongsheng, etc. proposed the trade-off matrix model of competency post matching, as shown in Figure 1. According to the level of employee orientation and post orientation, the model formed four competency post matching types: mild type, post selection, post determination and conflict type. Each type has its own characteristics. It is impractical to give priority to post or personnel in the process of organization development. Therefore, it is particularly important to develop an effective competency model for the post to achieve the dynamic balance between employee orientation and post orientation, so as to achieve the ability post matching.
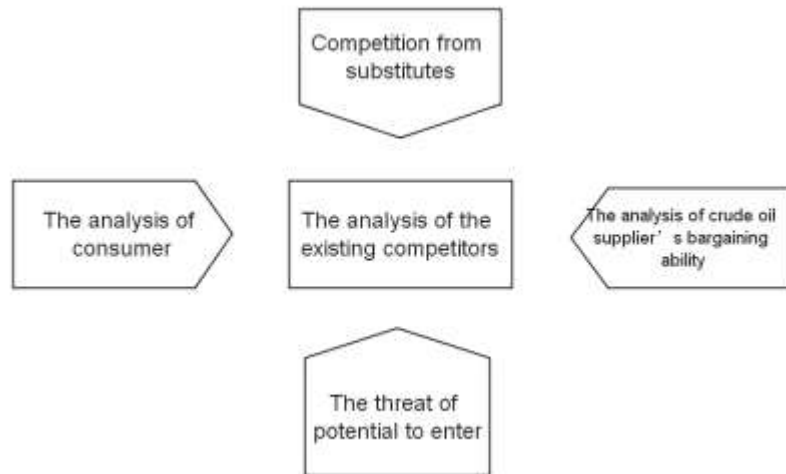
Fig 1: Power balance matrix model of ability post matching

3.2 Idiosyncratic factor theory

In the early 20th century, a large number of immigrants came into the United States; A large number of farmers enter the city; Retired soldiers joined the employment army; Under the background of unemployment after leaving school, Frank Parsons, a professor at Boston University, put forward the theory of attribute factors in his book "choosing a career". The core of the theory is the matching of personality and professional factors. The theoretical premise is that everyone has a series of unique characteristics, and they can be measured objectively and effectively; Each occupation has its specific factors, and different occupations need different characteristics of personnel; It is a very easy process to choose a profession, and it is possible to match the position of the person; The closer the personal characteristics and work requirements are, the more likely the career will be successful.

The theoretical connotation of idiosyncratic factors is that on the basis of a clear understanding of individual's subjective conditions and social occupation post demand conditions, the subjective and objective conditions are compared and matched with social occupation post, and finally a job matching with individual is selected. It can be said that the professional guidance based on the theory of trait factors is based on the evaluation of human characteristics. It puts forward the idea of person job matching in career decision-making, and the theory of talent evaluation widely used in today's enterprises is mostly developed on the basis of this theory. In particular, the recruitment and selection of talents based on post competency of enterprises strive to meet the requirements of people's knowledge, skills, personality, values and post competency, which is also an embodiment of the requirements of the theory of idiosyncratic factors.

3.3 Theory of competency model

Morrison and other scholars at home and abroad have studied the important role of competency model in post allocation. They believe that competency model enables enterprises to clarify the quality of excellent post performance, and provide specific direction for the implementation of post matching. In the competency model theory, iceberg model and onion model are two internationally recognized theories to build competency model. The following are brief introduction to the two models:

(1) Iceberg model

The model was developed from the iceberg theory of psychoanalysis school and put forward by psychologist McClelland in 1973. On the other hand, Spencer and his wife have made some improvements. They believe that competence consists of knowledge and skills, social role, self-image, personality and motivation. These parts, like icebergs, are distributed "above the water" and "below the water". Among them, the part on the water mainly includes knowledge and skills, which is called explicit competency; The part under the water is mainly composed of social role, self-image, personality and motivation, which is called recessive competence. Explicit competency is easy to be observed and evaluated, and can be obtained through training, but it is not the key factor to distinguish performance; Tacit competence is not easy to be observed and evaluated, and it is difficult to obtain through the acquired training, but it is the key factor to distinguish the excellent group from the general group.

(2) Onion model

In 1981, on the basis of McClelland's research, Richard boyatzis put forward the onion model similar to the iceberg model in his book competent managers: an effective performance model, and discussed its construction method and process in detail" The "onion model" generalizes competency quality as the core motivation from the inside out, and the structure wrapped with personality, self-image and values, social role, attitude, knowledge and skills. The outer competency elements, such as knowledge and skills, can be acquired by postnatal training, which is equivalent to the upper part of the "iceberg model". The more inward, the competency elements, such as motivation and personality, which are difficult to acquire through postnatal learning, are equivalent to the lower part of the "Iceberg Model", which are the key factors to distinguish performance. The similarities between the onion model and the iceberg model are that they both emphasize the core quality that can predict a person's long-term performance, that is, they have the same essence.
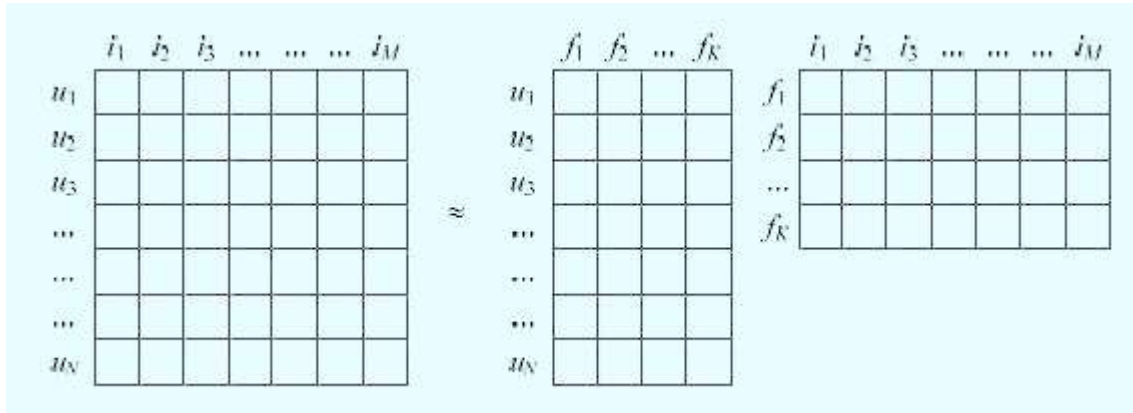
Fig 2: Onion model of competency

IV. COMPETENCY ANALYSIS AND MODEL CONSTRUCTION BASED ON POST DEMAND

4.1 Analysis of post demand

Generally speaking, the job description in the enterprise recruitment advertisement can effectively reflect its needs, and the competency with higher demand in the enterprise may be repeatedly mentioned in the job description. Therefore, this study calculates the TF-IDF (word frequency inverse document frequency) of each competency as the weight, as an indicator of job demand. TF-IDF (term frequency – inverse document frequency) is mainly used to measure the importance of a word in a document of a corpus. The main idea is: the importance of a word is directly proportional to the number of times it appears in the document, and inversely proportional to the number of documents containing the word in the whole corpus. Therefore, it is expressed as the product of term frequency (TF) and inverse document frequency (IDF). Word frequency refers to the frequency of a word appearing in a document. In order to eliminate the influence of different document length, it is often normalized in calculation, and the calculation formula is Formula 1. The calculation formula of inverse document frequency is equation 2. Therefore, the TF-IDF value of the word is expressed in Formula 3.

$$tf_{i,j} = \frac{n_{i,j}}{\sum_k n_{k,j}} \quad (1)$$

$$idf_i = log \frac{|D|}{1 + |(j : t_i \in d_j)|} \quad (2)$$

$$tfidf_{ij} = tf_{ij} \times idf_i \quad (3)$$

In order to calculate the demand degree of each competency in human resource management positions, ten thousand recruitment positions are selected from 165811 recruitment advertisements. According to the above formula, each job description is taken as a document, and a total of 10000 job descriptions are taken as the total corpus. The higher the frequency of a competency in the job description, and the less the number of job descriptions containing the competency in the total corpus, the greater the job demand of the competency. The TF-IDF value of each competency of human resource class is calculated as the weight, and the results are sorted. The higher the ranking is, the higher the enterprise demand of the competency in human resource management positions is. Using python programming language to write related programs, calculate the TF-IDF value of each competency in 10000 job descriptions of human resource management recruitment, and select the top ten competency for visual display. Performance management, labor relations, staff training and other professional skills in the post has a high demand. In addition, due to the human resource management work involves labor and the handling of the relationship with the staff, so the knowledge of laws and regulations and certain practical experience also have a high demand in the post. At the same time, with the promotion of the strategic position of human resource managers, the demand of enterprises for their decision-making, incentive, strategic planning and other aspects of quality also rises. Each human resource is divided into core, unique, important and general categories, as shown in Table 1.

TABLE I. Classification of human resources

	TECHNICAL TYPE	MANAGEMENT TYPE	MARKETING TYPE	FINANCIAL TYPE
CORE CLASS	Senior Engineer / senior technical worker	General Manager / Regional Manager	Marketing Director	Chief financial officer
IMPORTANT CATEGORY	Engineer / intermediate technician	Branch or department manager	Regional marketing director	Financial director of branch company
UNIQUE CATEGORY	Technical Observer	Integrated observer	Marketing observer	Financial observer
GENERAL CATEGORY	Assistant Engineer / Technician	Grassroots managers	Salesman	General financial staff

4.2 Construction of competency model of human resource management

The core competency of the top 30 with the total weight is matched with the word vector generated in the previous chapter, and the K-mean clustering method is used for clustering analysis. According to the elbow rule, K is determined to be 4, so competency is aggregated into a four factor model. The core competencies in factor one are professional ethics, pressure, professionalism and dedication, which are mainly related to personal characteristics and values, so they are named as individual characteristics. Factor 2 is mainly composed of eight core competencies, including decision-making, motivation, cultural construction, strategic planning and echelon construction, which mainly involves the strategic level of the enterprise, so it is named strategic contribution. Factor three is composed of nine core competencies, including communication and coordination, planning, team leadership, writing ability, data analysis, etc., which are mainly related to work responsibilities. It is a necessary function for human resource management personnel to successfully complete their work, so it is named function promotion. Factor four is mainly composed of six human resource management professional skills and knowledge, such as laws and regulations, performance management, psychology, labor relations, so it is named professional skills. Finally, on-the-job training should be carried out for on-the-job personnel to guide their later career development and improve their technical level, management ability or service ability. Through the above measures, while reducing the cost of products, we can develop new products, select and train new product production and sales management personnel, and successfully realize the second venture. As shown in Table 2.

TABLE II. Human resource demand of high tech enterprises in recession

		CORE CLASS	IMPORTANT CATEGORY	UNIQUE CATEGORY	GENERAL CATEGORY
HUMAN RESOURCE ALLOCATION IN RECESSION	Technology	Very important	Important	Important	
	Marketing	Very important	Important		
	Management	Important			

	Finance	Impo rtant			
KEY TASKS	Saving cost, developing new products and markets				
ACQUISIT ION OF HUMAN RESOURCES	External recruitment and internal job transfer training				

To sum up, the human resource management competency model constructed in this study is mainly composed of four factors: individual characteristics, strategic contribution, function promotion and professional skills. In the definition of this study, individual characteristics refer to the personality, quality, values and deep-seated ability of an individual at work. Employees are required to show a high level of professionalism, dedication and professional ethics, and be able to effectively cope with the challenges and pressure in work. Strategic contribution refers to the relatively macro ability that an individual has related to the company's strategy. Employees are required to contribute to the enterprise in terms of team cohesion and cultural construction, and can effectively cope with the internal and external challenges of the enterprise. They can make decisive decisions and take necessary actions under specific circumstances.

V. CONCLUSION

This study is based on the challenge of the development of big data era and online recruitment for human resource management, starting from the needs of enterprises, through the mining of recruitment advertising data of enterprises in online recruitment, to explore the competency of human resource management personnel and build a competency model. At the same time, through the expert observation and scoring, the resume data is associated with the competency model to further explore the influence of the variables in the resume on the competency, and summarize the clues in the career development path of human resource managers. Finally, we use machine learning algorithm to build competency prediction model, and realize the application of competency model in resume screening, so as to help enterprises accurately locate high-quality talents and effectively realize the ability post matching in resume screening.

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REFERENCES

[1] Du Lanying, Zhang Shanjin. Human Resource Allocation and Labor Market Construction in China. Business Research, 2006 (13): 96-98

[2] Zhang Yali, Cai Junping, Cai Jue. Investigation and Analysis of Nursing Human Resource Allocation and Demand in Traditional Chinese Medicine Hospitals. Chinese Journal of Nursing, 2007,42 (011): 1028-1030

[3] Tian Xiuyun. Ethical Thinking of Human Resource Allocation and Management. Morality and Civilization, 2001, 000 (002): 33-36

[4] Wang Jinxiu, Huang Hongfa. Discussion on Human Resource Allocation and Management Mode in Modern Enterprises. Jiangxi Social Sciences, 2003 (12): 159-162

[5] Dong Wanyue, Bai Ruhai, Chen Xiaotong. Spatial Analysis of Health Human Resource Allocation Level in China. China Health Policy Research, 2018, 12 (3)

[6] Qiu Ligu, Si Yafei, Zhang Xuewen. Study on Human Resource Allocation of Different Types of Community Health Service Centers. China Health Management, 2019, 036 (002): 93-96

[7] Wang Zhigui. on the Standard of Rational Allocation on Human Resources. Journal of Fujian Normal University: Philosophy and Social Sciences

[8] Su Ning, Peng Ying Chun, Wang Ya Dong. Research on Human Resource Allocation of Community General Practice Team Based on Work Analysis. Chinese Journal of General Practice, 2010 (28): 3147-3149

[9] Qian Weining, Zhou Aoying. Analysis of Existing Clustering Algorithms from Multiple Perspectives. Acta Software Sinica, 2002 (08): 1382-1394

[10] Xie Kunwu, Bi Xiaoling, Ye Bin, Xie Kunwu, Bi Xiaoling. High Dimensional Data Clustering Algorithm Based on Unit Region. Computer Research and Development, 2007, 44 (9): 1618-1623