

Application of Machine Learning in Digital Human Resource Management

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Abstract: In today's high-speed information age, many problems of the traditional human resource management (HRM) system make it impossible to effectively analyze massive data in today's enterprise competition and development. Machine learning, as a novel field of research in computer science in recent decades, provides a potential solution to the current problems faced by HRM systems. This study focuses on strategic HRM, an essential means of shaping employee behavior, and a vital information transmission channel in the CEO's transformational leadership behavior. By reviewing past literature on machine learning and exploring the principles of the practical application of machine learning in HRM, this paper also focuses on the intermediary mechanism between enterprise performance and the latest progress in machine learning and HRM. Further, the study tries to summarize and refine the opportunities and challenges that HRM faces in developing HRM and possible future research directions and hotspots.

1 INTRODUCTION

With the increasing popularity of information management, the information management system has become an indispensable tool in the competition and development of enterprises. However, modern enterprises' human resource management (HRM) system faces many problems, such as manual input of a large amount of data, chaotic and inconsistent data format, and inability to effectively manage and analyze massive amounts of data.

With the advent of the information age, more and more data are generated by the development of enterprises. With such a large amount of data, it is impossible to manage and analyze it artificially, so the information management system, software with data collection, database creation, and data management (including data storage and extraction), was born. It is capable of unified management and analysis of large amounts of data.

The HRM system is an information management system that combines HRM and information technology. As an information processing tool and a resource management specification, the HRM system primarily aims to standardize the human resource department's business process through the human resource information system and improve the transparency of HRM, etc. [4]. The HRM system plays a vital role in the enterprise due to its powerful functions, such as optimizing business processes, improving work efficiency, and improving management models. Thus, its quality is directly related to the enterprise's performance and affects its survival and development.

Machine learning is a research field dedicated to understanding and building "learning" methods. It uses a large amount of sample data to construct a model through

calculations (called training data) and then uses the model to predict, reason, and make decisions. In enterprise HRM, there will be a large amount of personnel data, including employee rosters, employee resumes, salary data, etc. These data can provide samples for machine learning [1], train different models according to the needs of enterprise HRM, and ultimately predict relevant business data [2-3] to promote the digital transformation of enterprise HRM, thereby improving enterprise HRM [4-5].

To master the traditional machine learning development framework, users need not only to have the ability of program development but also to have mathematics knowledge in probability theory, mathematical statistics, and linear algebra. Therefore, the application of this technology has a certain threshold [6-7]. In order to widely apply machine learning technology to the field of human resources, a relatively easy-to-use machine learning framework is needed.

2 LITERATURE REVIEW

2.1 Applications of Machine Learning

Machine learning is divided into three categories: supervised, unsupervised, and reinforcement learning. Supervised learning produces an inference function that predicts an outcome given a single input object. In supervised learning, each training set data comprises an input object (usually a vector containing multiple features) and an expected output value (also called a label) to supervise the learning algorithm to analyze the training data and generate an inference function. It is equivalent to inferring

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unknown labels through existing data. Whereas unsupervised learning is an algorithm that learns patterns from unlabeled data, reinforcement learning concerns how an intelligent agent should act in an environment to maximize cumulative reward. The ML.NET framework supports a variety of machine learning tasks.

2.2 Data set preparation

This article uses the "IBM 34 columns" provided on the Kaggle data modeling and analysis competition platform, all of which are feature values, as shown in Table 1. In this data source, Although the eigenvalues of "Education", "Environment Satisfaction", "Job Involvement", "job satisfaction", "Performance Rating", "Relationship Satisfaction", and "work-life balance" are integers, they can also be regarded as categorical variables because they have fewer values.

Table 1 Feature Column Information

Label name	Meaning	Data type
Age	Age	Integer
BusinessTravel	Trip Frequency	String (classification)
DailyRate	Daily salary	Integer
Department	Department	Classification
Distance-FromHome	Distance from home	Integer
Education	Education level	Integer (classification)
...	...	...

2.3 CEO Transformational Leadership Behavior and Corporate Performance

Transformational leadership behavior is a process in which leaders communicate vision and expectations to employees and motivate employees. It is characterized by emphasizing shared vision, stimulating employees' intrinsic motivation and high-level needs, and focusing on realizing long-term corporate goals. It is led by vision, idealized influence, and intelligence. Motivation and individualized care consist of four mutually reinforcing and reinforcing dimensions. [7] Visionary leadership refers to the ability of a leader to create and present an attractive vision, give challenging and meaningful tasks, and encourage employees to achieve high-level goals. Idealized influence describes the leader's organizational behavior stemming from personal characteristics to set an example, exert a profound influence on employees, and generate respect, trust, and admiration. Intellectual stimulation is the ability to challenge the status quo and assumptions of the organization and seek new perspectives on old problems. Inspiring employees to innovate Personalized care is the ability of leaders to provide individualized support and encouragement, create a learning atmosphere and growth opportunities, and help employees achieve self-realization and develop high-level potential.

Existing studies have shown from multiple theoretical perspectives that transformational leadership behaviors can improve corporate performance [9]. As the top leader, strategy maker, resource allocator, and final action

selector of the company, the CEO plays an essential role in developing small and medium-sized enterprises. Under the environment, its transformational leadership behavior undoubtedly has a more significant impact on firm performance. CEOs of small and medium-sized enterprises can experience more personal and participate in the process of strategy and daily operation activities, and have more opportunities to make employees full of passion through visionary leadership to achieve beyond-expected work results by stimulating employees' potential and high-level needs and achieving more than expected work results through intellectual stimulation. Make employees aware of the significance of the tasks they undertake, improve the consistency of goals by strengthening the senior management team's communication, enhance organizational learning by creating a good organizational learning atmosphere, and vigorously stimulate organizational innovation by creating a corporate culture oriented to change and innovation. Creating and sharing visions enhances corporate cohesion and centripetal force, enabling SMEs to have better environmental adaptability, survival, and profitability. Chen Jianxun verified the positive impact of transformational leadership behavior on technological innovation, exploratory innovation, and organizational performance from different dimensions. There is a significant positive impact on firm performance.

2.4 Strategic HRM and Enterprise Performance

Strategic HRM refers to a series of internally consistent human resource arrangements committed to achieving corporate goals and are highly consistent with corporate strategy. All human resource activities at the level, including integrating human resources at the policy and functional levels to achieve corporate goals, [9] Compared with traditional HRM, strategic HRM integrates human resource activities into corporate strategy. More emphasis is placed on making full use of the strategy implementation process to promote organizational change and development [10]. Its essence lies in the continuous fit and matching of human resources and corporate strategy, and it is committed to achieving internal consistency and external fit of HRM. The former emphasizes. The consistency and coordination within the human resource system are the basis for the effective execution of human resource functions and realizing the latter. The latter focuses on matching human resource policies and practices, corporate strategies, and the external environment and is the key to achieving excellent performance.

As one of the fundamental theories of strategic HRM, the behavioral theory proposes, based on resource-based theory and capability theory, that the capabilities and behaviors of human resources in an enterprise are the basis for the realization of corporate strategic goals Different strategies and goals require specific employee skills and behaviors, and efforts to achieve the best between corporate strategy and human resource supply

Combined strategic HRM is a crucial tool to guide and strengthen employees' "specific" or "appropriate" skills and behaviors by telling employees what behaviors are

"important," "should be," and "rewarded" [7,8]. This makes employees exhibit the attitudes and behaviors expected by the organization, thereby contributing to realizing organizational strategies and goals. Therefore, strategic HRM can develop and configure specific employee capabilities and behaviors according to corporate strategy needs. These specific employee skills and behaviors that match the strategy can significantly enhance the company's competitive advantage and performance. Based on the viewpoint of the behavioral school, Wei Liqun and others proposed that strategic HRM can improve corporate performance by forming a developmental corporate culture within the company and realizing the effective matching between HRM and corporate strategy.



Fig. 1. Theoretical model

3 PRINCIPLES OF MACHINE LEARNING AND PREDICTIVE ANALYTICS

Artificial intelligence usually refers to the technology that performs human cognition tasks requiring a certain level of intelligence. Unlike other ordinary software, artificial intelligence uses integrated high-quality data and fast calculation algorithms for high-speed calculations, making artificial intelligence in daily life. It remains stable and accurate in the application. Among the different branches of artificial intelligence, machine learning is the method of choice developed for applications such as computer vision, speech recognition, natural language processing, robotic control, etc. Specifically, as one of the subsets of artificial intelligence, machine learning refers to creating programs based on data rather than programming rules and then autonomously learning from a large amount of data and based on these data to make high internal validity. Future predictions and autonomous execution of routine and non-routine tasks. As shown in Figure 1, in a business environment, machine learning establishes an understanding of data training by identifying different requirements and standards and then generates model evaluation and deployment based on the standard data mining process, manifested as data analysis. Subsequently, machine learning can prepare and model by deploying the model on the online monitoring platform, etc., using the output results to make predictions (involving recommendations, warnings, optimal planning, etc.) to solve various problems. Generally speaking, when applied to specific scenarios, the most commonly used method of machine learning technology is the "supervised" function (supervised machine learning in Figure 2). That is, by creating a machine learning algorithm, determining the most appropriate measurement method to evaluate its accuracy, and using the samples to train the algorithm. Data-driven decision-making using machine learning principles has been shown

to have a stronger correlation with positive organizational-level outcomes than other decision-making approaches based on phenomena or experience. This is because, with the massive amount of information that emerges with the complexity of the external environment, people are under the pressure of organizational competition and development and need to process a large amount of information quickly and make correct and reasonable decisions. High time pressure can easily lead to management. In comparison, the advantage of machine learning is that it can quickly process routine tasks in daily work in a short period by using computers with almost unlimited processing power. At the same time, based on different Algorithms, it can also help managers complete non-routine cognitive tasks.

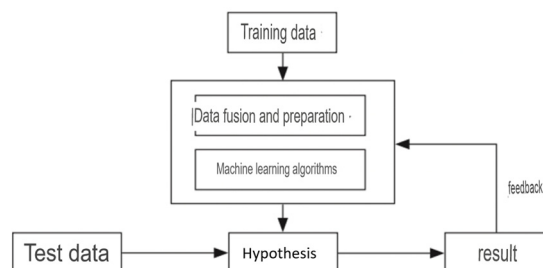


Fig. 2. Schematic diagram of machine learning

3.1 Machine learning algorithm screening

The field of machine learning investigates ways to replicate human learning processes using machines. We are aware that people have utilised computers in the past to solve problems. It is typical to make use of the computer's effective parallel processing to enable the computer to meet human needs and pass the test. In order to better address problems, machine learning now relies on huge data, only based on training and data mining, while examining the intrinsic relationship between the data from the actual problem and the degree of influence on the problem. Today, machine learning has many applications in life. There are many applications of machine learning in life, including computer vision, natural language processing, speech recognition, and other fields. It has been used in a wide range of fields such as computer vision, natural language processing, and speech recognition.

3.1.1 Systematic clustering algorithm

The hierarchical clustering algorithm, also known as the systematic clustering algorithm, is a type of clustering technique that is increasingly popular both domestically and internationally. It clusters data layers at a time. The guide will combine all classes into one class and complete the machine learning process by breaking the samples up into several classes and choose the class with the shortest distance between all classes to merge. Small classes can be aggregated from bottom to top, which is known as the coalescing method, while large classes (cluster) can be divided from top to bottom, known as the splitting method. The coalescing method is typically used more frequently. In the coalescence method, each sample point is first treated as a class cluster, with the size of the original class

cluster being equal to the number of sample points. These initial class clusters are then merged based on a set of criteria, and the process continues until a predetermined condition or a predetermined number of points is reached. Then, until a predetermined condition is satisfied or a predetermined number of categories is attained, these initial clusters are joined based on some criteria. The key actions comprise:

1. Establishing M initial pattern sample classes, indicated by the notations $Y1(0)$, $Y2(0)$, ..., $Ym(0)$, and the class-to-class (2) figuring out the separation between courses.

2. Creating a distance matrix $D(m)$ depending on the way distance between classes is calculated, then identify the smallest member in $D(m)$. For instance, if the distance between $Yi(m)$ and $Yj(m)$ is the lowest element, the distance between $Yi(m)$ and $Yj(m)$ is calculated based on the spacing between $Yi(m)$ and $Yj(m)$, establishing a new classification of $Y1(m+1)$, $Y2(m+1)$, ..., $Ym(m+1)$.

3. Determining the distance matrix $D(m+1)$ by calculating the distances between the merged new classes, and then determine the distances between $Yij(m+1)$ and the other unmerged classes $Y1(m+1)$, $Y2(m+1)$, ..., $Ym(m+1)$.

4. If, after the aforementioned computation and merging, the desired clustering result is not obtained, go back to step two and repeat the process until the desired clustering result is attained. (4) If, after the aforementioned computation and merging, the desired clustering result is not attained, go back to step two and repeat the process until it is. The system can automatically identify the groups based on the distance between the data, which is the key benefit of this clustering approach.

4 CHALLENGES AND FUTURE RESEARCH DIRECTIONS OF MACHINE LEARNING IN THE FIELD OF HUMAN RESOURCE MANAGEMENT

In the previous article, this study explained machine learning and the prediction principles behind it and, at the same time, reviewed and sorted out the application scenarios of artificial intelligence/machine learning in the context of HRM. Based on the above conclusions, this study also focuses on the latest developments in machine learning and HRM, trying to summarize and refine the opportunities and challenges that HRM faces in the development of HRM, including possible future research directions and research in the field of academic research.

Scholars have explained the relationship between big data and enterprise costs and benefits from different perspectives, such as action-network theory, socio-technical system approach, and resource-based view. They have analyzed the impacts it produces in organizations and society. Positive effects such as sustainable competitive advantage have been explored. However, for the artificial intelligence-based HRM practice based on big data, people need to be cautious about dealing with ethical and moral issues in machine learning for decision support. Artificial intelligence-based HRM is based on introducing artificial intelligence, machine learning, deep learning, and other applications. During the application process, it is

necessary to collect and analyze a large amount of data related to forecasting work. Ethical issues go hand in hand. As mentioned above, enterprises have adopted different "monitoring methods," such as the analysis of email texts, surveillance video in the office, common clocking in and out of work, and usage data of APPs on mobile phones and computers, etc. Introducing these measures may be the most direct manifestation of the invasion of privacy.

5 DISCUSSIONS

Many enterprises face the problem of "not turning" in promoting the digital transformation of HRM. The key is that the enterprise needs to form a deep understanding and precise understanding of digital transformation from top to bottom and has failed to raise the transformation to a strategic level. Putting digital transformation into practice is challenging because of a clear strategic direction and maintaining a high degree of unity. The main manifestations are as follows: First, the understanding of some enterprises on the digital transformation of HRM is often limited to the upgrading and expansion of informatization or IT systems, that is, by purchasing professional software systems and using information tools to optimize the functions of HRM and business, realizing the transfer of some traditional businesses from offline to online. Second, due to solidified traditional thinking or weak foundation, some enterprises need help adapting to the digital development model or choosing a suitable entry point, resulting in ambiguity in the direction of subsequent applications and difficulty in generating corresponding value. Third, some companies promote digital transformation based on HRM but fail to involve other aspects related to this and need to provide sufficient element supply and firm support. For example, there is a disconnect between strategic planning and organizational culture, which seriously limits the process of digital transformation work, and it is not easy to exert comprehensive effects.

5.1 Weak Foundation for Scientific and Technological Innovation Within the Enterprise

Many enterprises have fallen into the "cannot be transferred" situation in promoting the digital transformation of HRM. The key is that the internal technological foundation of the enterprise is weak, and the technical knowledge reserve is seriously insufficient. It is easy to give up at the beginning. The main manifestations are as follows: First, there is a lot of personnel in the enterprise who can engage in HRM, but there are relatively few compound talents who have both management ability and digital application ability. They cannot use digital tools, and it is not easy to meet the needs of higher-end human resources to manage activities. Second, when the new system is launched in the digital transformation process, historical data needs to be imported into the new system, which is prone to problems such as missing data, heavy workload, and data mismatch, posing a threat to enterprises' current and subsequent operations. Third, suppose an enterprise adopts an outsourced system platform for digital transformation. In that case, it usually means that the relevant data of the

enterprise will be uploaded to the cloud platform, which will quickly lead to the leakage of critical data, including personnel structure, salary, level, background, etc., creating challenges to internal data security. Fourth, in the face of a large amount of data after transformation, the lack of technical capabilities and relevant management personnel needs in-depth data analysis capabilities, which may lead to the waste of value of transformed data.

5.2 The Difficulty to Achieve Coordination Among Organizational Departments

Many enterprises have fallen into the situation of "not daring to change" in promoting the digital transformation of HRM. The key is that this work is an important work that "touches the whole body" and involves personnel, funds, and organizational structure. Many aspects, such as business processes and management models, if not handled properly, will cause certain costs and risk losses, causing many companies to hesitate. The main manifestations are as follows: First, the digital transformation of HRM is a collection of cross-functional systems. Second, in the traditional view, the human resource department cannot directly create value for the enterprise. It is mainly responsible for administrative affairs, daily management of employees, etc. The corresponding support is relatively less, and more is to rely on other business departments to promote digital transformation; third, the digital transformation of HRM needs to be adjusted according to the overall human resource strategy of the enterprise.

6 CONCLUSIONS

Today, the digital economy has deeply penetrated all levels of the social economy, significantly affecting the development of different industrial fields, and has become the most dynamic, innovative, and widely radiating economic form. One of the core growth poles. Since 2018, a series of policies, measures, and suggestions have been introduced from the state to the local level to encourage the development of the digital economy and support relevant enterprises to accelerate the implementation of digital transformation to promote development. Driven by the new generation of information and communication technologies represented by cloud computing, big data, the Internet of Things, artificial intelligence, and 5G, HRM has also begun to enter an era of all-things intelligence with comprehensive perception, reliable transmission, intelligent processing, and precise decision-making. , that is, to take digital knowledge and information as the key production factors, digital technology innovation as the core driving force, and modern information network as an essential carrier to continuously improve the digital and intelligent level of HRM activities. In the face of future development trends, the digital transformation of HRM must continue. Instead, it needs to actively combine future trends to accelerate innovation, think about the function positioning and transformation direction in the new era, and explore ways and paths for innovation and breakthroughs. Only in this way can it be formed to promote the new kinetic

energy of enterprise development to serve market competition and sustainable growth.

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