

A Conceptual Artificial Intelligence Application Framework in Human Resource Management

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Qiong Jia, Hohai University, China, jiaqionghit@163.com

Yue Guo*, Hohai University, China, yueggcn@aliyun.com

Rong Li, Hohai University, China, lirong98@163.com

Yurong Li, Hohai University, China, liyurong1221@163.com

Yuwei Chen, Washington University in St. Louis, China, 756575524@qq.com

ABSTRACT

This study proposes a conceptual framework of artificial intelligence (AI) technology application for human resource management (HRM). Based on the theory of the six basic dimensions of human resource management, which includes human resource strategy and planning, recruitment, training and development process, performance management, salary evaluation, and the employee relationship management, is combined with its potential corresponding AI technology application. With the case analysis on recruitment of leap.ai and online training of Baidu, the recruitment dimension and training dimension with AI are further explored. Finally, the practical implication and future study are supplemented. This AIHRM conceptual model provides suggestions and directions for the development of AI in enterprise human resource management.

Keywords: Six dimensions of human resources management, artificial intelligence technology, intelligent recruitment system, intelligent training system

*Corresponding author

INTRODUCTION

With the development of Artificial Intelligence (AI) technology, a new generation of labor, such as the human intelligence of artificial intelligence, has become the key factor for enterprises to survive and transform in a changing environment (Ertel, 2018). Since Google's Alpha Go system has won an overwhelming victory in the battle with South Korean player Lee Sedol, artificial intelligence has attracted attentions of both researchers and practitioners (AlphaGo, 2016). Artificial intelligence, also known as machine intelligence, is an interdisciplinary science that mimics human capabilities and intellectual behavior. Elaine Rich defines AI as "Artificial Intelligence is the study of how to make computers do things at which, at the moment, people are better" (Rich, 1983). In the process of simulating the information process of human consciousness and thinking, it can quickly retrieve the database, extract information, answer our doubts efficiently, and provide the best answer directly and rationally. Artificial intelligence theory and technology applications are also expanding, and many artificial intelligence tools, such as artificial neural networks, intelligent decision systems, and fuzzy sets, are used in various fields (Holland, 1992). Among them, the application of AI in the field of human resource management is still in the exploration stage (Sheila, 2018).

AI has been gradually applied to enterprise management decision making, taking on and helping managers to speed up their tedious and repetitive daily work. It provides powerful database and analytical support, allowing managers to get out of mechanical work and engage in more valuable work (Partridge & Hussain, 1992). According to the Accenture strategic report, for coordination and governance, problem solving and collaboration, employee and community, strategy and innovation work, the utility and impact of intelligent systems can change the manager's work contents. Artificial intelligence can undertake and help managers speed up their daily tedious and repetitive work. It can also provide powerful database and analytical support, so that managers can get away from the repetitive work and get devoted to more valuable work. Human resource management refers to a series of human resources policies and corresponding management activities of enterprises. These activities mainly include the formulation of corporate human resources strategies, recruitment and selection of employees, training and development, performance management, compensation management, employee mobility management, employee relationship management, employee safety and health management (Noe *et al.*, 2006). In the process of human resource management, the use of artificial intelligence technology can bring greater economic benefits. Improving the efficiency of human resource management through the application of AI technology has become an important trend in the future development of human resource management.

However, in the research area of human resource management, there is still a lack of an overall AI application framework, combined with the specific dimensions of human resource management, to analyze its specific application. Therefore, based on the six dimensions of human resource management and the main technical applications of AI, this paper proposes a conceptual AI application to HRM model to guide enterprises how to use AI technology to assist human resource management. Based on the

analysis of the Leap.ai and Baidu industrial cases, we discuss the AI application practice of recruitment and training. The proposed AIHRM framework provides theoretical guidance and application recommendations for the combination of human resource management and AI technology. Potential future research areas are also proposed.

The next part of this paper discusses the relevant theoretical literature. The third part presents the conceptual framework model of AI in HRM application. The fourth part is a case study in conjunction with Leap.ai. The last section is the conclusion.

LITERATURE REVIEW

Artificial Intelligence

The status quo of artificial intelligence technology can be analyzed from three levels, the basic support layer, the platform framework layer and the domain technology layer (Brooks, 1991).

The Basic Support Layer

The three major factors in the success of this layer of AI technology are big data, computing power and new models. Big data provides fuel for the development of AI. In recent years, the new enhanced algorithm model has greatly improved machine learning capabilities. A typical representative of this aspect is deep learning. It performs well in tasks such as supervised learning, unsupervised learning, and intensive learning.

Platform Framework Layer

Internet companies such as Google, Facebook, Microsoft, Baidu and Amazon, as well as universities such as the University of California at Berkeley and the University of Montreal in Canada have launched their own deep learning framework. Advanced deep learning technologies are expected to be applied with a small amount of customization and deployment, greatly reducing the burden on developers and businesses.

The Technology Layer

Artificial intelligence technology has been applied to various fields. The technology application network is shown in Figure 1. Depending on the problem domain, the main technologies include the computer vision and natural language processing technologies. At present, more mature technologies include face recognition technology applied in the airports and payment, such as Alipay. Natural language processing programs computers to process and analyze large amounts of natural language data. Related technologies have been widely used in translation software (such as correct translation), search engines, question and answer systems (such as knowledge), sentiment analysis and automatic answering; speech recognition and so on. For example, voice assistants represented by Apple Siri, Microsoft Cortana and Google Now has be setup on the user's mobile phone and computer. Smart speakers represented by Amazon Echo, already have tens of thousands of family-users. Speech recognition technology is one of the core technologies of these devices.

Six Dimensions of Human Resource Management

The six dimensions of human resource management are interconnected and interact to form an effective human resource management system, as shown in Figure 2. Among them,

- (1) Human resource planning is the starting point of human resource management. It mainly helps the organization to predict the future needs of personnel and the basic qualities of personnel through the plan.
- (2) Recruitment and deployment, with human resource planning as input, is equivalent to the organization's blood, providing nutrition to the organization, solving organizational staffing and staff matching issues.
- (3) Training and development, the theme is "education";
- (4) Performance management is the core of the six dimensions. It is also the main input for other dimensions.
- (5) Compensation management aims to motivate employees to solve problems in the company.
- (6) Employee relationship management aims to manage personnel and help the company form an effective cycle of rational allocation of human resources (Noe *et al.*, 2006).

AI Study in Human Resource Management

The development of Human Resource Information System (HRIS) has provided a foundation for AI application. HRIS With the development of human-computer interaction functions of AI, there is also possibilities for managers to improve management efficiency by using AI. "HRIS is a procedure for collecting, storing, maintaining, retrieving and validating data needed by an organization about its human resources, personnel activities, and organization unit characteristics"(Kovach & Cathcart, 1999; Lippert & Michael Swiercz, 2005). HRIS can assist the strategic planning with information for labor force supply and demand forecasts; dealing with applicant qualifications; development with information on training; and evaluating performance with information and so on. However, compared with AIHRM, the information system is more dealing with data input and storage, the intelligence decision assistance function is still limited. The artificial intelligence can further strengthen the business analytic abilities of the system to provide further references output for decision making. Data mining methods are also proposed for scanning the e-resume. Expert systems are proposed to solving the knowledge management in the enterprises. The controversy on

whether AI can replace the human resources is also discussed (Turban & Frenzel, 1992; HRP, 2017). There is still a research gap between the AI technology application study in HRM fields.

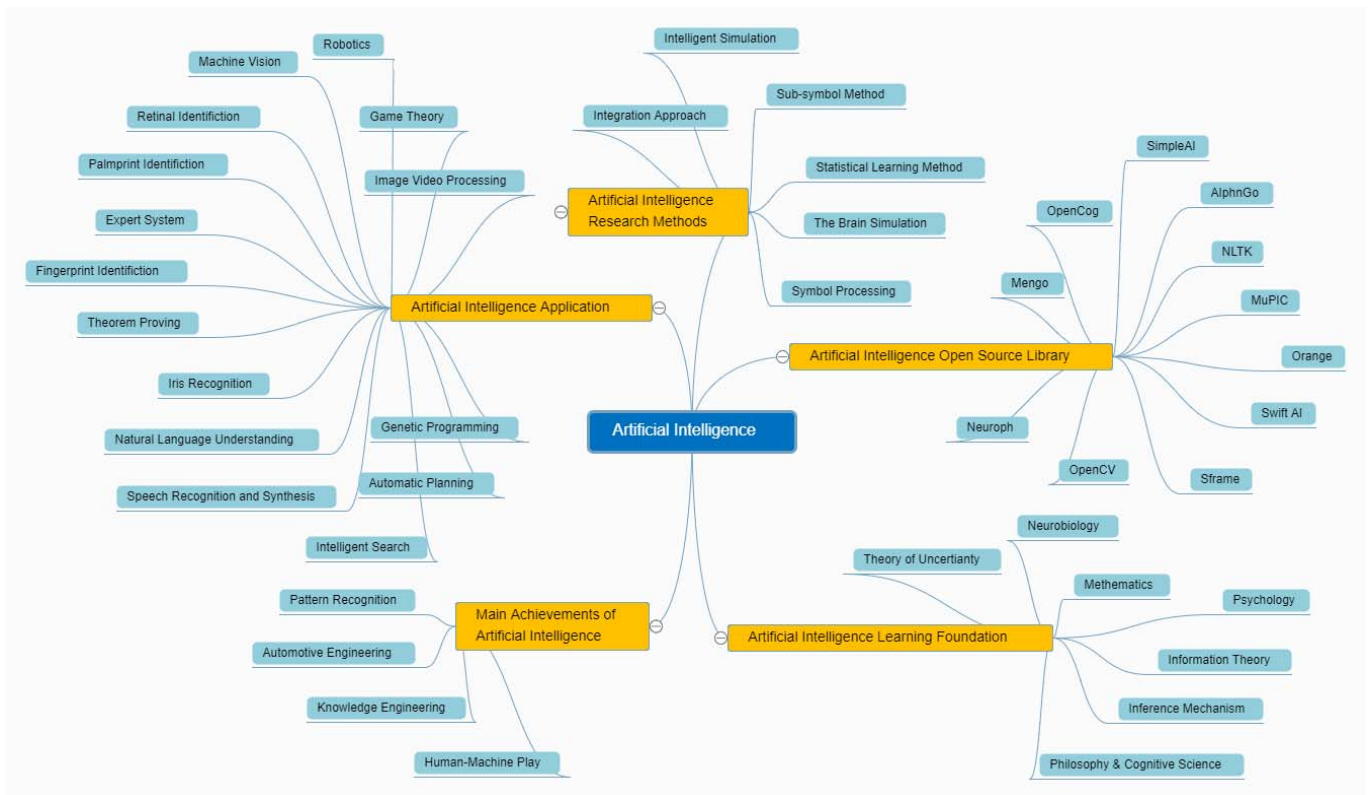


Figure 1: The AI technology network.



Figure 2: Six dimensions of human resource management.

CONCEPTUAL AI APPLICATION MODEL FOR HRM

The design of the "AI+HRM" model framework is mainly to assist the human resource managers to make better decisions more efficiently facing large amount of information. The framework answers how the AI can be combined with Human Resource Management. The corresponding relations among the human resource management, AI detailed technology, and the formed Intelligent System are described and explained, as shown in Figure 3.

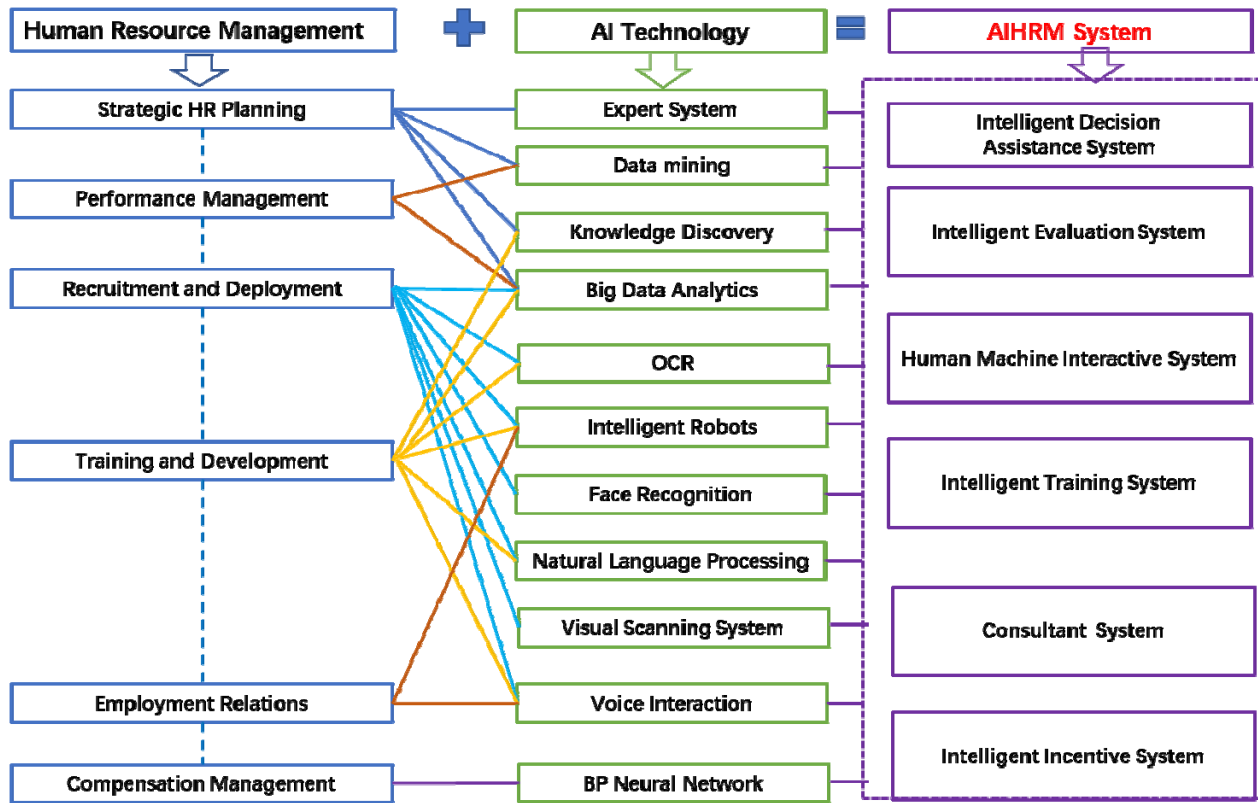


Figure 3: A conceptual model for artificial intelligence application in human resource management .

Human Resources Strategy and Planning

Human resource strategic planning is the starting point of HRM. Managers use artificial intelligence technology as an auxiliary decision-making system, which can carry out strategic planning more comprehensively. First, technologies such as data mining and knowledge discovery are needed to collect global information and combine with existing internal and external information. After summarizing the information, we can understand the current rationality of the human resources situation and forecast, evaluate and adjust the company's future management. Relying on the statistical and modification functions of the intelligent decision support system, the report is finally provided with various required information.

Recruitment and Deployment

As an important part of the system, the recruitment process includes review, screening resumes, interviewing candidates, matching suitable positions, etc. Ideal Corp, a software company that uses artificial intelligence to automate recruitment tasks, its CEO Somen Mondal says that the biggest impact of artificial intelligence is to automatically screen candidates and reduce bias. Artificial intelligence can learn the qualifications for successful employees in a particular position and apply this knowledge to select qualified candidates and score and rate candidates. According to Mondal, the company used artificial intelligence software to recruit, with a 71% reduction in recruitment costs and a threefold increase in recruitment efficiency (Denise, 2017).

First, the Optical Character Recognition (OCR) is used to identify paper resumes and pictures, or use the big data method to filter electronic resumes, analyze resumes, combine the characteristics of resume and text information extraction techniques, through matching, correlation analysis and statistical analysis. The database can be converted into a structured resume in seconds and push the candidate's resume to the company accurately and quickly. At the same time, through the analysis of resume and job matching,

the system can recommend suitable positions to candidates, especially for some high-end talents. In this process, AI has the characteristics of screening the candidates without prejudice (Hutson, 2017).

During the interview process, the company set up a recruitment model and the robot asks questions to the candidate. The enterprise can set the corresponding problem of matching posts and the keyword extension problem from candidates' answers. For example, if the candidate has engaged in data development related work, the robot will query the operation flow, and query which database to use according to the answer. The answer can be evaluated by collecting the keywords and similar word meanings. If the interviewer has doubts, he can re-watch the video. Artificial intelligence converts a 15-minute video interview into a set of 20,000 data points for facial movements, intonation and word selection. The system can help the interviewer greatly improve the efficiency of the interview without reducing the quality of the interview.

Face recognition techniques can be used in the exam to determine if the candidate is consistent with the document, thereby preventing others from taking the test instead of the candidate (Jain & Li, 2011). The use of natural language processing technology eliminates the need for typing, and the conversion from speech to text does not require much time, which will greatly improve the efficiency and accuracy of the recruiter's work. In addition, the system can also choose a reasonable interviewer by using the voice test method to carry out effective recruitment. After that, the big data method is used to collect candidate information, screen vacancies, match the interview results of the hired personnel, analyze their personality characteristics, advantages and disadvantages, and match the corresponding positions through analysis of personality and IQ/EQ test. At the same time, employees can be tested regularly (such as the annual). Using artificial intelligence can help managers to identify new employees with the greatest potential for success and deploy them in the right team. The intelligent system can also help employees to matching the right supervisors, recommend learning opportunities and career paths, and even suggest that they are at risk of leaving. It can also help to re-match jobs for employees who have a willingness to change jobs.

Training and Development

In the process of continuous development, both internal development and external impacts continue to push employees forward. Using a variety of artificial intelligence technologies, it can be more comprehensive to help enterprises to form a learning organization culture, which avoids the ordinary teaching design model based on the traditional gap analysis of the ability model. (Human resources managers need to conduct research and identify gaps of employees and group them through various analysis methods such as questionnaires, interviews, job observations, assessments, and job data analysis.)

First, training instructors can be artificially intelligent. During the training process, the robot training instructor can use the visual scanning system to observe the daily learning status of each student, accurately calculate the average value of all students' attention, and then retrieve the teaching events of different stimulation levels through data analysis. The instructors can also adjust the level of relaxation and the teaching rhythm according to students feedback. The curiosity of these students who interacts frequently with robots is also enhanced (Oshima *et al.*, 2012). In addition, through big data analysis, enterprise training can extract the part of employees who need to learn from the vast knowledge base, form a customized employee curriculum, comprehensively test and locate the staff level through technical means, and intelligently promote tailor-made courses.

In the training process, artificial intelligence technology can help the students to automatically record training data. The intuitive data is analyzed to show the degree and effect of employee learning, which saves time for training managers and allows managers to quickly learn about training results. In addition, companies can use voice technology, learning content database, and core algorithm to achieve a fast and efficient learning experience. AI teachers can not only improve the quality of learning and learning efficiency, but also significantly reduce the operation and management of online and offline training. AI teachers can also become an all-round assistant, from statistical learning data to outputting high-quality learning reports; from supervising students to learning automatic rankings. AI teachers will redefine the basic logic of instructional design. The employees can simply enter the learning objectives, the archives and learn key points, and the course will be completed automatically by the AI teacher. In order to realize the core work from the definition of learning methods to the definition of problem-solving knowledge transfer, the "intellectual" construction will become the core content of the AI era curriculum designers.

Performance Management

In performance management, the performance appraisal model can be embedded into the system with collecting and analyzing the information about employees' work performance. Using the intelligent decision support system, some scientific evaluation methods, such as 360-degree performance evaluation methods, can be used more automatically and quickly (Otley, 1999). These assessment methods are programmed and entered into the decision support system to more effectively count employee evaluation results.

At the beginning of the year, the business objectives of each department of the company can be setup. The system can evaluate the individual performance targets, access control punch card system records, resignation system, department manager score, personal score, peer score, customer score and make other comprehensive analysis and evaluation. With the AI assistance, the decision-

makers can analyze the achievement of each indicator, propose the defects of the failed indicators, formulate and implement practical new indicators, and propose upgrade plans. The future performance objectives can also be setup with forecasting the future trend.

Compensation Management

Compensation management, or salary management is a dynamic management process which determines, assigns, and adjusts employee compensation principles, strategies, levels, structures, and factors that with the guidance of organizational development strategies (Henderson, 2003).

AI application can assist to facilitate fairness of the compensation management. BP neural network is a supervised artificial intelligence technology based on biology, neurology, psychology and statistics. It can imitate the human brain nervous system, establish a regular computing model, and integrate multiple neural network nodes (Richard & Lippmann, 1991). BP neural network system can be used to design an intelligent decision support system to form a fair salary evaluation system with the input of the big data .

Employee Relationship Management

Employee relationship management includes corporate culture and labor relations, coordinating the relationship between employers and employees. In terms of labor relationship management and communication management, artificial intelligence technology can be used as an auxiliary system to solve many complicated process stereotypes, undertake management tasks, and act as performers, assistants, and consultants.

The assistant primarily supports the manager and his team, such as recording, scheduling, reporting, or maintaining a scorecard. Examples of artificial intelligence applications in this area include the "Virtual Assistant System", which organizes meetings by reading and composing emails, coordinating participants, and managing calendars. In the process, these intelligent systems will gradually improve relevant knowledge and expand service areas by absorbing the experience of themselves and their colleagues. These systems extend the definition of workplace artificial intelligence and become the so-called "advisor system".

CASE STUDY

Leap.ai

Leap.ai was founded in the United States in 2016 by Yunkai Zhou (Leap.ai co-founder and CTO) and others, focusing on building a career development platform for all positions in high-tech companies. They match job seekers and recruiters in a high-quality manner through the use of artificial intelligence technology (Denise, 2017).

Business Model of Leap.ai

First, job seekers make related applications on the website and improves relevant information, including professional experience, advantages, career preferences, etc.. The platform uses artificial intelligence algorithms to compare the resumes uploaded by individual users with the corporate recruitment criteria. The final recommended positions will be further confirmed to improve accuracy. Most of the recruitment-related companies in the market mainly emphasize what the job seekers have done. In contrast, Leap.ai not only presents the job experience of job seekers, but also integrates factors such as work ability and job search preferences to job seekers to recommend more matching job opportunities.

Although Leap.ai's business model is the same as that of traditional headhunting companies or recruitment websites, Leap.ai leverages artificial intelligence to provide customized, refined, and standardized services. For example, if a job seeker looks for a product manager position on a traditional recruitment website, the general process is to first search for "product manager", and then the website extracts all product manager related information from the database according to keyword extraction. Then the user may receive thousands of results even they don't have time to read. Leap.ai analyzes the user based on the data and directly presents the required results, providing users with efficient and convenient choices. In addition to providing accurate choices for job seekers, it also provides targeted guidance and feedback, and helps establish standardized builds and transform them into high-quality resume formats. At present, Leap.ai has accumulated tens of thousands of end users, mainly in the United States, and its cooperative companies include technology giants such as Baidu, Alibaba, Didi, Uber and Ant Financial.

Matching AIHRM Mechanism of Leap.ai

Leap's key AI solution is subtly referred to as JUMP - Job User Matching Forecast. The team uses a variety of artificial intelligence techniques, including natural language processing, to understand each job and each user, and then predicts the likelihood that the user will be hired to work. For example, Leap considers the user's values, skills, strengths, location, company and job preferences, recruiting company requirements and culture, and uses machine learning to determine the best match for each user.

The team also uses AI technology throughout the product experience. For example, users can upload resumes on the welcome page and immediately get real-time results to determine which positions match may be appropriate for the system. After the artificial

intelligence system is matched, there is also a human review of the matching results by the human expert before the notification is obtained. Results are available within one business day.

Users can also try to use AI's Leap Resume to get real-time feedback on improving resume strength and improvement. By intelligently matching resumes, users get the best chance, and leap also introduces users directly to partner companies to streamline the entire job search process. By understanding each other's matching reasons, users can explore their own strengths and weaknesses hidden in them, and even explore more hidden opportunities and better present them on their resumes.

Leap.ai mainly uses ai technology, which simplifies the matching of job seekers and corporate talent needs. In countless resumes or job requirements, it screens out several candidates matching each other and provides them to cooperative enterprises, which greatly simplifies recruitment. The process better presents the advantages and individuality of the job seekers and recruits the right talents for the company. The company uses professional experience, work ability and corporate culture as three key factors to explore talent preferences and personality characteristics, and combine with the company's cultural background to achieve the needs of both parties.

Baidu University

Introduction to Baidu University

The division of labor between humans and machines is undergoing different changes. Baidu University is trying to use AI to build enterprise online learning, and let AI be used by corporate employees. On the Baidu AI open platform, everyone can use AI to learn more abilities, and the frontier experimenters who combine human intelligence and artificial intelligence effectively reserve more potential for their future career development (Wu, 2018).

AI and Training of Baidu University

Using artificial intelligence technology, attendants can empower your business, accelerate the growth of your business and employees, and quickly acquire more fresh knowledge. The voice automatic recognition technology can directly add letters to the video when learning online. The collected tens of thousands of student research reports can be quickly analyzed using natural language processing. For example, in a survey of open student questions at Baidu University, a total of 220,000 words of text were collected. It takes at least 5 hours to read by hand, but with artificial intelligence, it takes only 5 seconds to get clear results. This helps employers to better understand the employers needs and categorize and tailor to adequate curriculum.

IBM AI Driven HR

As a pioneer, IBM is arranging A.I. for its HR department with different functions, including measuring employee sentiment, increasing engagement, enhancing employee education, customize and design job requisitions, and acquiring new, diverse talent (Verne, 2018)

IBM provides HR solutions with its IBM Talent Management system to help enterprises to acquire, assess, and develop employees. Talent acquisition, talent assessments, talent development are the three subdivided modules of their solutions for improving HR in enterprises. Each modules are assisted with AI technology. For talent acquisition, IBM Watson candidate assistant is provide as an AI and cognitive talent management solution. Fitting the job seekers skills and the organization's needs, the AI robots in the systems interact with the job seekers and engage them by chatting in system. This assistant in the framework also identifies the skills needed for jobs in different industries and define the best practice for each job, including interview questions, coaching tips, SMART goals and prescriptive learning suggestions(IBM, 2018; Eric 2017).

FUTURE STUDY AND PRACTICAL IMPLICATIONS

The Collaboration of Human and Machine

The future trend of the AI for HRM is still the collaboration of human and machine with the existence of confliction. The McKinsey Global Institute believes that "more than 30% of activities in 60% of occupations can be replaced by artificial intelligence"(Chui & Francisco, 2017). According to a research report from the University of Oxford, in the next 10 to 20 years, half of the 702 jobs in the United States will disappear under the influence of IT, and nearly 47% of US employees will be employed. Based on these data, how to elevate the competitive intelligence of human resource managers and deploy the human resources efficiently may be very difficult to handle with.

How to collaborate the human and machine with using the developing technologies is also an important question. The large-scale rise in unemployment rate also will cause opposition and resistance. In detail, in each dimension of human resource management, there are worthy researching questions to be answered. For example, the process design for the matching between job seekers and providers based on HR model and AI. The intelligent performance evaluation system combined with the AI algorithms and performance evaluation standards (Dom, 2018).

Data Driven Human Resource Management Analytics and Information System

To maintain the competitive advantages, enterprises can make strategic plan for the AI transforming by gradually building the internal data analytical system and improving information system. This will provide foundation for embedding with AI system. For each dimension of the HRM, the new AI technology can be attempted. Recruiting and Training can be the starting points as shown by cases analysis. The machine learning techniques for the employees' performance prediction can also be applied for practice and research. The analytics of AI can also be applied for understanding organizational behaviors with data input.

Real Application Process, Advantages, and Risks

AI and HR combination has been undeniable trend in the HR revolutions. The current mature application is for recruiting, using chatbot and machine learning. Machine learning and augmented learning algorithms are being developed to provide smart solutions for human resource management (Jill, 2018). However, most enterprises now are still not ready for AI application in HR. This process is not only a technology diffusion, but also a merge with strategy, organizational behaviors, enterprise culture and management process in the enterprise. So how to design and implement the AI technology into HR practice gradually is still worth exploring. Except for the advantages of AI brings to HR, there are also risks may exist, such as data exposure and inadvertent misuse (Josh 2018). How to avoid such risks is also an interesting topic.

CONCLUSIONS

This study proposes a conceptual AI framework for HRM, based on the six dimensions of HRM and status quo of AI technologies. Human resource strategy and planning combined with data mining and knowledge discovery can form a corresponding intelligent decision support system; The recruitment process is combined with face recognition and natural language processing technologies to establish an interview system; During the training and development process, intelligent robots and visual scanning technologies can assist people to teach and learn; The performance management procedure can be utilized with data mining technology, forming an intelligent incentive system; An intelligent salary evaluation system can be constructed by applying neural network system; Finally, the employee relationship management can be assisted with robot and voice interaction technologies to form a corporate advisory system. With the cases analysis on recruitment of leap.ai and online training of Baidu, the recruitment dimension and training dimension with AI are further explored. Finally, the practical implication and future study are supplemented. This AIHRM conceptual model provides suggestions and directions for the development of AI in enterprise human resource management.

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