Development trend and Challenge Analysis of Manufacturing Industry Under the Background of Artificial Intelligence

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Abstract. Artificial Intelligence (AI), as a new technology emerging in recent years, has received great attention in various fields. For the manufacturing industry, the ability to integrate artificial intelligence technology into the production process of manufacturing can improve the productivity of manufacturing enterprises. This paper discusses the development trend of the manufacturing industry in the context of artificial intelligence technology. It analyses several advantages of AI technology applied to the manufacturing industry, including innovation in technology, helping enterprises to achieve the optimization of human resources as well as improving the matching degree of the market. Based on the above advantages, the integration of artificial intelligence in the manufacturing industry can be further developed. At the same time, this paper also analyses the current integration of artificial intelligence technology problems and difficulties and puts forward suggestions. The results of this paper can be proved for the integration of artificial intelligence into the manufacturing industry, confirming that the integration of artificial intelligence plays a great role in the development of the manufacturing industry.

Keywords: Artificial Intelligence, Manufacturing industry, production efficiency.

1. Introduction

Manufacturing is an important application area for Artificial Intelligence (AI) innovation and technology, and the deep integration of AI and manufacturing is triggering far-reaching industrial changes. Better promoting the development of AI and giving full play to the role of AI in promoting the transformation and upgrading of the manufacturing industry is crucial for the country to optimize its economic structure and enhance its international competitiveness. It is understood that AI, as an important technology leading the fourth technological revolution, has slowly begun to penetrate the manufacturing sector [1]. Capgemini's research report stated that more than 50% of the top manufacturing companies in Europe apply AI, followed by 30% in Japan and 28% in the United States [2]. The full integration of AI with manufacturing has brought about a complete paradigm shift in technology. However, the application of AI within an organization is complex and involves not only changes in production practices but also shifts in management styles and mindsets [3].

Due to China's manufacturing sector's insufficient degree of information technology adoption in recent years, there has been a noticeable gap between it and the developed countries, placing China's manufacturing sector at the bottom of the global value chain for a long time. Due to a lack of expertise, capital, and understanding of information technology, the majority of Chinese businesses are struggling with their information technology systems. As a result, it is still fairly usual for businesses to adopt a waiting-and-watching approach. And enterprises in Europe and the United States to study how to deepen the problem of information technology. Chinese enterprises in the implementation of information technology are relatively more passive components, enterprise information technology construction is more dependent on the government and software vendors to promote the two sides. As China's current manufacturing industry lacks complex talents in management and information technology, resulting in information asymmetry often occurs when enterprises and suppliers interface, and suppliers therefore find it difficult to provide enterprises with accurate information technology and material supply. In addition, with the gradual disappearance of the demographic dividend, labor costs have risen sharply [4]. In this case, the Chinese manufacturing industry will be at a competitive disadvantage. Facing the double pressure at home and abroad, Chinese manufacturing enterprises

urgently need to master artificial intelligence technology, integrate it into the current production technology, and realize the upgrading of production technology, so as to regain the competitive advantage in the international competition.

This paper explores the relationship between AI and production methods and manufacturing productivity and explores whether AI technology can produce a technological breakthrough in the manufacturing industry. It analyzes the current situation of the integration of AI and manufacturing from several aspects and looks forward to the development trend. At the same time, the difficulties in the integration of AI and manufacturing are discussed. It offers theoretical support for the growth of the industrial sector in developing nations.

2. Artificial Intelligence Leads Innovation in Production Technology

Artificial Intelligence can enhance manufacturing production by facilitating the ability to innovate with technological logic in the manufacturing industry and thus enhance the production level of the manufacturing industry. According to endogenous growth theory, technological progress is a pivotal factor in ensuring sustained economic growth [5]. The creation of Artificial Intelligence technology can facilitate the research and development of manufacturing technology to a great extent. Companies can take advantage of AI technology in terms of data and easily access the information and data required by the industry. In addition, AI can simulate humans to achieve intelligent automation of complex tasks, simplify the content of workers' operations through operational instructions, reduce the time cost of technicians, and improve production efficiency, so that technicians can devote more energy to operationally complex and highly creative work to create higher labor value, which makes it possible to improve labor productivity in the manufacturing industry. For example, AI can establish a virtual testing system to test the feasibility of new technologies, which can reduce the cost of research and development of new technologies, shorten the research and development cycle, and improve the efficiency of innovation [6]. The specific analysis is as follows.

2.1. Product Development

Artificial intelligence technology can provide designers with technical support for simulation and verification before designing the products. Design software with integrated AI modules. Design software with integrated AI modules can better improve design efficiency [7]. For example, when designing some plastic products, it is necessary to consider the expansion and contraction of the material during the production process, and if the change of plastic material is calculated in the traditional way there may be a large error. Using the technology of artificial intelligence to calculate the data of plastic materials, it is possible to reduce the error and improve the accuracy of the analysis results. Throughout the different stages of design, machine learning can be used to help users find similar designs, thus speeding up the design process.

2.2. Equipment Maintenance

Artificial intelligence technology can also provide technical support for maintenance in manufacturing companies. For large manufacturing companies, it is very important that the equipment on the assembly line can operate properly, so the maintenance of the equipment is highly valued. Artificial intelligence technology in equipment maintenance mainly provides predictive maintenance [7]. Predictive maintenance is different from the traditional maintenance of equipment after damage or periodic maintenance. Predictive maintenance predicts the state of wear and tear of equipment by collecting vibration data, lubricant data, and temperature changes in various parts of the equipment unit. Utilizing artificial intelligence to train models, it compares the data with the actual operation and issues timely alerts to remind maintenance personnel to carry out timely inspection and repair before equipment damage, effectively reducing downtime. The system can improve the safety of the production system and effectively reduce.

2.3. Product Manufacturing

In many manufacturing processes, AI machine learning can be used to build models to find the most appropriate equipment parameters. For example, in the injection molding process, the temperature of the material, the cooling time, and other elements need to be taken into account to ensure the integrity of the material. Artificial intelligence can then collect the various factors that affect the injection molding process, such as the temperature of the workshop, the style of the cooling system, the temperature of the production plant, etc., and build models to find out the most suitable equipment parameters.

2.4. Quality Testing

Machine vision technology plays a huge role in the link of product quality inspection [7]. It can greatly improve the accuracy and efficiency of detecting product defects. For example, Dell needs to detect whether computer parts are damaged during the production process and whether there are scratches on the parts. The traditional detection method is to require specialised inspectors to carry out sample testing, this detection method on the one hand, due to the differences between people makes it difficult to unify the detection standards, on the other hand, the same person at different times, in different states will also affect the implementation of the detection standards. If the vision technology of artificial intelligence is used, the detection standard can be unified and the detection efficiency can be improved [8]. Only artificial intelligence needs to be trained on the images of the sampled products, and the machine vision system can effectively extract the features of the inspected products and judge whether the products are qualified or not. As shown in Fig. 1, the machine vision system can scan and detect scratches, bubbles, deformation and other different degrees of damage to the surface of the product production process [7]. The technology has now begun to be used in various manufacturing enterprises and has been proven to be able to effectively improve the efficiency of product detection.

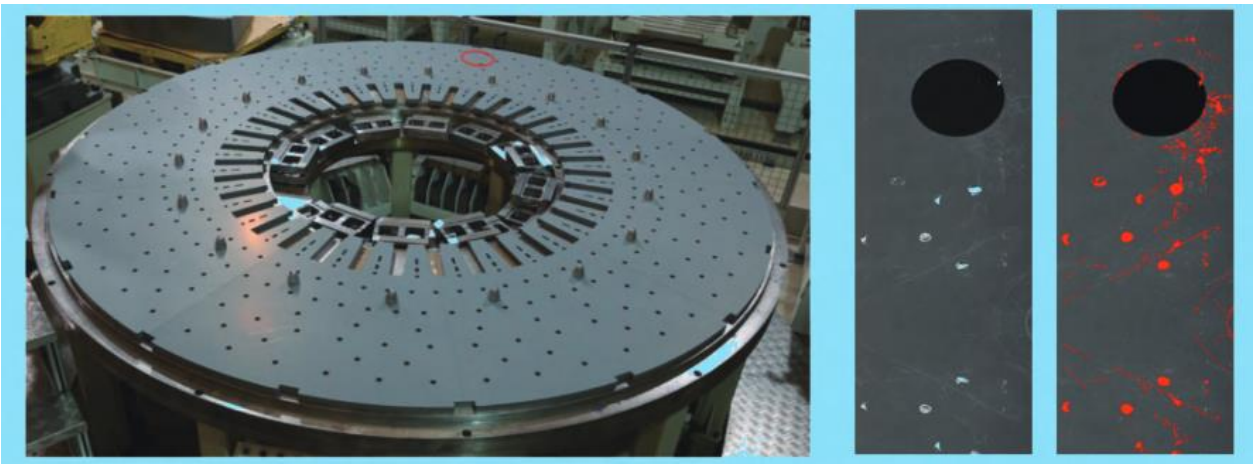


Fig. 1 Machine vision system quality inspection [7]

3. Artificial Intelligence Optimize Human Resource Structures

Artificial Intelligence can improve productivity in the manufacturing industry by optimizing the structure of human resources. According to ACEMOGLU, productivity can only be maximized when technology is matched with human resources. When put into the manufacturing industry, AI technology, although advanced, requires the cooperation of the labor force [9]. Therefore, when AI technology penetrates the manufacturing industry, the human resources of the manufacturing industry should be optimized to adapt to the new technology. The change of artificial intelligence in human resources structure is mainly reflected in the following two aspects. Firstly, the introduction of artificial intelligence technology will replace the relatively low-level labor force. Some scholars have found that jobs that are repeatable and require long hours of operation are more likely to be replaced

by AI [10]. For example, when AI is applied to the production process, AI robots can replace workers to complete the welding, assembly, painting and other production processes, and can be more efficient than the workers to complete a higher degree of completion. Correspondingly, the replaced workers can be trained to master the new technology of AI, so as to be qualified for the new positions in the context of AI. This is one of the ways in which AI can optimize the structure of manpower. Secondly, under the background of artificial intelligence, the manufacturing industry will greatly increase the demand for talent in this field, for example, enterprises will need a large number of talents who are proficient in programming, automation and other related fields, to help enterprises adapt to the new technology update faster.

4. Artificial Intelligence Improves Market Matching Degree

Artificial intelligence can improve manufacturing productivity by improving market matching efficiency. Currently, with the development of the economy, people's demand for products gradually appeared refinement, and customization characteristics. So, the traditional manufacturing industry produces assembly line products gradually difficult to meet customer demand. Businesses can employ artificial intelligence technology to tailor their manufacturing processes closer to customer needs in order to boost supply and demand matching and increase production efficiency in light of the present state of the market. The advantage of artificial intelligence is that it can integrate and analyses huge amounts of data, build market prediction models, and give forward-looking advice on product design to better meet consumer demand. When the products produced by manufacturing enterprises can more accurately match the needs of consumers, after a series of production, sales efficiency will be greatly improved, the production plant can obtain timely equipment configuration, greatly reducing the economic losses caused by the mismatch between supply and demand [2].

5. The Difficulty of Integrating Artificial Intelligence with Manufacturing

There are also a series of difficulties in the promotion and application of artificial intelligence in China's manufacturing industry. The first is technology. Technology can only become a practical solution by inventing, integrating and adapting to the production activities of a specific enterprise, which requires that all robot technologies are relatively mature and have stable performance. At present, although robotics technology has been relatively mature in some aspects, including information retrieval, rough motor skills and optimization planning, many aspects still need further research and development.

In addition, there are some difficulties in data collection. Due to the long history of the manufacturing industry, different countries, and different companies may use different standards of network protocols, and interfaces, and many private protocol standards were introduced by many vendors in the early days. So how to carry out unified collection and management of data is one of the major difficulties.

Besides, at present, most of the talents engaged in the research of AI algorithms are concentrated in universities or scientific research institutes, and there are few AI researchers in manufacturing enterprises, and the composite talents who are proficient in manufacturing and AI are even fewer. When artificial intelligence is applied to manufacturing production, a lot of specialized knowledge is required, so the lack of composite talents is another major difficulty in integration.

6. Suggestions

How to implement AI technology in business is the biggest difficulty facing the industrial sector. Deep AI technology integration into China's manufacturing sector is now a lengthy process. It is possible to learn from the successful experience of developed countries in integrating AI into the manufacturing industry [2]. The fundamental purpose of the integration of AI into manufacturing is to improve product quality and production efficiency and reduce costs. First, carry out a deep

combination of industry, academia and research. The application of artificial intelligence technology at the enterprise level is individual and unique, while scientists' research is a common technology, and there is a big gap between technology supply and demand. AI solutions for enterprises must not only be in line with their own differentiated production activities but must also be in line with their realistic capital and cost affordability. Therefore, in order to develop viable AI solutions, enterprises not only need to establish internal corresponding technical teams but also cooperate with scientists distributed in research institutes or leading enterprises, that have established cross-departmental AI working groups to prototype solutions and conduct tests on business departments, in order to solve the personalized know-how faced by enterprises.

In the process of the application of artificial intelligence in practice, manufacturing enterprises should first make good reserves, collect and accumulate data, sort out the professional field knowledge accumulated by the enterprise over the years, and combine the existing software and hardware foundation, analyses the entry point of artificial intelligence technology in the application of various production links, find and establish suitable models, and then carry out pilots in some manufacturing links where the conditions are ripe.

Secondly, Enhanced talent development and employee training are also important. Artificial Intelligence is a general-purpose technology that will be integrated with various industries, and there will be a large talent gap in the future. First of all, it is necessary to strengthen the cultivation and introduction of high-end talents. Formulate AI-related education and research programs, vigorously cultivate high-end talents, and create a favorable environment for the growth of talents. Introduce special programs and preferential policies to attract the world's best talents. programs and preferential policies to attract the best talents in the world. Second, the institutional mechanism of higher education should be reorganized to strengthen the construction of related disciplines and incorporate AI into compulsory public courses. Third, vocational education and employee retraining should be strengthened. Vocational artificial intelligence education and employee training play a crucial role in the application of artificial intelligence in enterprises. Instead of commanding and operating robots, future enterprise employees will have to work with robots, which not only requires that employees master relevant skills, but also cultivate new thinking patterns and cultural values.

7. Conclusion

This paper analyses the application of artificial intelligence in manufacturing, the advantages that exist compared to traditional manufacturing and the challenges that remain in terms of technology and personnel. Artificial intelligence has now begun to be initially applied to part of the manufacturing industry, in many aspects of manufacturing technology has a certain degree of improvement, and has been proven to improve the production efficiency of manufacturing enterprises. So for developing countries, the manufacturing industry enterprises can learn from the developed countries in the advanced results of artificial intelligence and intelligent manufacturing, the use of artificial intelligence for the natural advantages of the data, to achieve a win-win situation in the integration of the manufacturing industry.

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