Intelligent Manufacturing: a Way to Upgrade Manufacturing Industry

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Intelligent Manufacturing: a Way to Upgrade Manufacturing Industry

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Abstract. From manufacturing industry to intelligent manufacturing industry, China's manufacturing industry is entering a new intelligent production mode on a large scale. With the implementation of 4.0 policies in China's industry, it has further stimulated the endogenous power of the development of intelligent manufacturing in Chinese enterprises, and accelerated the development of intelligent factories and digital production workshops. The new production system of intelligent manufacturing emerges as the times require. In intelligent manufacturing, manufacturing enterprises implement individualized flexible production and control production cost according to market demand. This undoubtedly puts forward many new requirements for its production mode. 2018 can be said to be the key year to promote the development of intelligent manufacturing in China. In this trend, the traditional manufacturing industry upgrading is particularly important and has attracted much attention.

1. Introduction
Intelligent manufacturing is an important way to ensure the rapid development of our manufacturing industry. At present, our country is vigorously developing intelligent manufacturing, and has carried out intelligent production, and has established a professional system of intelligent manufacturing. Intelligent manufacturing is an upgrade mode after the perfect combination of information technology and industrialization. Intelligent manufacturing covers a variety of advanced technologies, such as manufacturing technology, information technology, automation technology and artificial intelligence. Now, the "intelligence" of intelligent manufacturing represents "smart", which is based on new digital information technology and new manufacturing technology and materials. Intelligent manufacturing runs through all aspects of product design, production, management and service[1]. It is a general term for advanced manufacturing processes, systems and patterns. It has the functions of deep information self-perception, autonomous decision-making, accurate control, self-execution, and so on[2]. In the process of intelligent manufacturing, multi-functional sensors and intelligent control system are used to realize intelligent activities such as self-perception, self-analysis, independent decision-making, reducing the time of equipment response problem, real-time feedback, optimizing production logistics, etc. In order to improve the production efficiency of enterprises, people develop intelligent manufacturing.

2. Development of intelligent manufacturing at home and abroad
With the rapid development of Internet technology and information digital technology, large-scale intelligent manufacturing is possible. In the second decade of the 21st century, intelligent manufacturing has developed rapidly in the world after more than a decade of technological
improvement. In order to enhance the strength of industrial manufacturing and cultivate the competitiveness of enterprises, the manufacturing powers are constantly introducing new measures to promote the development of the manufacturing industry.

In 2011, the United States implemented the "Advanced Manufacturing Partnership" strategy. Germany launched the "Industry 4.0" plans in 2013 and the UK launched its "High value manufacturing" strategy in 2014. Japan launched the New Robot Strategy in 2015[3]. The European Plan for the Digital Industry, published by the European Union in 2016. From "the 12th Five-Year Plan of Intelligent Manufacturing equipment Industry" to the official release of "made in China 2025" in 2015, the overall policy for the development of intelligent manufacturing industry has been gradually improved. These policies take the development of advanced manufacturing industry as the core goal, build the core technology of manufacturing industry, and gradually realize dream of making China a powerful country[4]. The rapid development of network information technology and advanced manufacturing industry provides favorable conditions for the development of intelligent manufacturing industry in China. The application of advanced technology, intelligent equipment in discrete manufacturing industry, and the application of manufacturing process control and manufacturing execution system can flexibly improve the production efficiency of manufacturing enterprises, which has certain theoretical and practical significance.

3. Three levels of intelligent manufacturing
As a new production mode, intelligent manufacturing has unique characteristics compared with traditional and advanced production mode. Intelligent manufacturing can be divided into three levels:

3.1. Intelligent manufacturing equipment
Intelligent manufacturing cannot be separated from the support of intelligent equipment, including advanced CNC machine tools, intelligent robots equipped with new sensors, intelligent complete production line, etc.

3.2. Intelligent manufacturing system
Intelligent manufacturing system, which is composed of intelligent equipment and human experts and physical information technology, is a kind of intelligent production system, and can continuously carry out autonomous learning and optimization.

3.3. Intelligent manufacturing services
Intelligent manufacturing services, product manufacturing processes and the Internet of things, covering product design, production, management and services. The entire life cycle of the product can be based on the customer's household's demand customizes the demand, finally forms the entire production service ecology chain.

Intelligent manufacturing enterprises manage the whole life cycle from product production to operation, so that intelligent manufacturing enterprises can effectively connect business with manufacturing process, and finally make factories flexible, intelligent and agile. Greatly optimize production efficiency and stability.

4. Research and development of intelligent manufacturing
By analyzing the present situation of intelligent manufacturing, we can see that the integration innovation and application demonstration of intelligent manufacturing mainly focus on perception, control, decision making, execution and so on[5]. The following are the key research directions of intelligent manufacturing:

4.1. Industrial robots
Industrial robot is an intelligent production equipment which integrates computer technology, manufacturing technology and automatic control technology. It has sensors and artificial intelligence
system. The fuselage consists of a fuselage, a controller, a servo drive system and a sensing device\cite{5}. It has the characteristics of personification, self control, repeatable programming and so on. Intelligent industrial robot can be based on the perception of environmental change, through the Internet of things, between machines and equipment, human-machine interaction, and the environment of independent judgment, decision-making, so as to reduce the production process of human dependence; service requires future robots to combine the Internet, on the basis of offline, to achieve online active clothing standardization refers to the realization of modularity and generalization of all kinds of components and components of the machine industry, which makes the use of industrial robots more convenient and reduces the manufacturing cost\cite{2}.

4.2. Intelligent numerical control machines tools
Intelligent NC machine tool is a kind of advanced NC machine tool with advanced manufacturing technology, information technology and intelligent technology\cite{6}. It can perceive its processing status, monitor, diagnose and control, can estimate its processing ability, and use historical data to estimate the service life of the equipment parts, and to evaluate the quality of the machining parts intelligently. Intelligent numerical control machines tool through various functional modules to achieve a variety of processing technology, improve processing efficiency\cite{7}. Its development presents the trend of intelligence, multi-function and miniaturization of control system.

4.3. 3D printing
Based on the digital model file, 3D printing technology applies the bonding material to the generation of 3D entity by successive physical layer superposition and layer by layer superposition. 3D printing technology combines digital modeling technology, electromechanical controllable technology, information technology, material science and chemistry, and so on. It is expected that in the future 3D printing technology will be more applied in the field of biomedical, aerospace, military and other small batch personalized needs.

4.4. Intelligent sensors
Intelligent sensor is a new type of sensor, which integrates perceived and controlled parameters into industrial networks. It has the characteristics of high performance, high reliability, multi-function, information perception, acquisition, diagonal and so on. It is the product of the integration of sensors and microprocessors. At the same time, it combines with Internet to realize data networking, real-time collection and transmission. In addition to industrial manufacturing, it can also be widely used in life services.

4.5. Intelligent logistics warehousing
In the framework of intelligent factory in industry 4.0, intelligent logistics warehousing is the core link between manufacturing and client, which is composed of hardware (intelligent logistics storage equipment) and software (intelligent logistics warehousing system)\cite{8}. The hardware includes automatic warehouse, multi-layer shuttle, tunnel stacker, automatic sorting machine, AGV car, etc. The software coordinate and manages the personnel, materials and information of the enterprise according to the actual business requirements. The Software puts information into the industrial Internet of things to make the whole production run efficiently. Intelligent logistics warehousing can reduce labor costs, improve management efficiency, which is the ultimate solution to reduce warehousing logistics costs\cite{9}. According to the network instruction given by the system, the loading and unloading equipment can accurately locate and grab the cargo to the designated position, and will be replaced by the trackless mobile robot in the future.

4.6. Intelligent tests and assembly equipment
The intelligent automatic detection device can accurately analyze the defects and defects of the target object, determine the size and position of the target object, and carry out automatic inspection and
assembly, so that the effective and stable control of product quality can improve the flexibility and reliability of production and improve production efficiency. According to the structure characteristics, the digital intelligent assembly system can plan the processing process and supply cycle of the product, and improve the utilization ratio of assembly equipment to the maximum extent. In addition to aerospace, automotive applications, intelligent testing and assembly equipment also having great potential in agricultural separation and environmental protection.

5. Conclusion
Intelligent manufacturing will lead the development of manufacturing industry in the future[10]. The arrival of the information age has triggered the global scientific and technological revolution and the integration of the world economy. The combination of information technology and modern industry will promote our manufacturing industry to a higher level of intelligent development. The future development trend of manufacturing industry will be "man-machine-intelligent manufacturing". Intelligent manufacturing can make the whole production process more flexible, personalized and personalized, and improve the production efficiency, as well as the competitiveness of the industry.

China should seize the opportunity to realize the transition from "manufacturing" to "intellectual creation". The industrial intelligence optimization and upgrading of Chinese manufacturing industry should be based on the actual situation, learn from the excellent experience of foreign countries, plan the long-term development road, and follow the path of development suitable for China.

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