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The Development and Research of Intelligent Manufacturing Technology and System

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Abstract

Since the reform and opening up, the rapid development and widespread use of information technology have propelled our country's manufacturing industry from the traditional physical realm to the digital realm. This transformation has been facilitated by advanced technologies such as wireless communication, the Internet of Things, artificial intelligence, and virtual reality. These technologies have provided robust support for the intelligent transformation of our manufacturing industry. At present, intelligent manufacturing technology and system technology are being widely applied in the research and development, design, manufacturing, management, operations, and maintenance services of both domestic and foreign manufacturing industries. This application is promoting the transformation of the manufacturing industry from being process-driven to being data-driven. Additionally, the integration of these technologies is evolving from single applications to comprehensive integration and collaborative innovation. As a result, the development of intelligent manufacturing, characterized by software definition, data-driven processes, platform support, value-added services, and smart leadership, is being accelerated. Improving the ability of design, manufacturing, management, and service has become a popular topic of active discussion and research in manufacturing enterprises. The revised text clarifies the ideas and improves the flow of the sentence. It also enhances the vocabulary and technical accuracy. The technology and system of intelligent manufacturing are important driving forces that promote the digitalization and intelligentization of the manufacturing industry in our country. This paper discusses the development and research of intelligent manufacturing technology and systems. It examines the development trends of international advanced manufacturing technology and systems, and explores the current application status of intelligent manufacturing technology and systems in the manufacturing industry. Furthermore, it proposes relevant application value and measures, aiming to provide scholars with valuable references, assistance, and suggestions.

Keywords

Intelligent Manufacturing, Manufacturing Technology and system, development status, application research

1. Introduction

At present, Japan, South Korea, Europe, the United States, and other countries are vigorously developing intelligent manufacturing technology and systems to establish a digital, intelligent manufacturing service system. Hyundai

Group proposed the concept of "Intelligent Manufacturing Production Line," "Intelligent Workshop," and "Intelligent Manufacturing Factory". They also put forward the development strategy of "Intelligent Manufacturing," which has facilitated the deep integration of new-generation IT technology and automobile manufacturing. In the field of digital design, the HICIMS integrated manufacturing platform, which is based on Napasteel technology from Finland and Windchill technology from PTC, has been proven to shorten the average design cycle of products by 25% and the construction cycle by 10% [1]. In addition, Japanese intelligent manufacturing has developed a small welding robot that can work in small, inaccessible places. The robot can also use various software to complete cutting, spraying, and other tasks. The LNG manufacturing simulation test system developed in the UK has been awarded the Lawrence Rough Technical Standard (AIP-RRB) certification [2]. South Korea's Samsung Heavy Industries applies digital technology to everything from design to manufacturing. They have partnered with Microsoft to create intelligent manufacturing plants that utilize the Internet of Things and automation. The manufacturing process is made intelligent to achieve the goal of "Paperless manufacturing" [3]. The revised text corrects grammar and punctuation errors, improves sentence structure, and enhances clarity and readability. On the intelligent manufacturing system, the Microsoft Azure Intelligent Cloud Platform combines artificial intelligence technology and metadata technology to establish a collaborative system among multiple manufacturing units. This system centralizes various types of data into a unified network database. The invention effectively achieves the benefits of reducing manufacturing costs and improving manufacturing efficiency for the manufacturing unit [4].

2. Intelligent Manufacturing Technology and system development analysis

2.1 Smart manufacturing technology

2.1.1 Intelligent Interaction Technology

As an essential component of intelligent manufacturing technology and systems, intelligent interaction technology is primarily utilized in robot communication. It plays a crucial role in data processing and analysis, enabling communication and interaction through AI technology. This ensures the operability and controllability of intelligent manufacturing technologies and systems. The application of artificial intelligence technology can optimize the manufacturing process and enable intelligent manufacturing. It can be applied to various aspects such as design, manufacturing operations, and maintenance. Advanced technologies like deep learning, virtual reality, virtual agents, biometrics, and others can be combined to enhance interactive performance.

2.1.2 Virtual Reality Technology

Virtual reality technology in intelligent manufacturing is primarily used to showcase product design and facilitate changes. In virtual reality technology, product features and performance can be displayed through 3D modeling, making it convenient for people to understand the product in real-time. Virtual reality technology can be utilized to simulate the design and testing of manufacturing products, optimizing the manufacturing process. This can effectively enhance the efficiency and quality of manufacturing enterprises.

2.1.3 Deep Learning

As an important component of intelligent manufacturing technology and systems, the artificial neural network (ANN) integrates with big data technology to enable efficient identification and assessment of various manufacturing modes. Through in-depth learning, the manufacturing process can be comprehensively optimized and innovated. At the same time, in-depth learning allows for the observation and positioning of the manufacturing process and enables the visualization and vivid display of the observation site [5]. For example, to gain a deeper understanding of the manufacturing process, relevant data is collected and analyzed using deep learning technology. This data is then used to build a manufacturing model, which is used to monitor and diagnose the operating conditions of manufacturing equipment. The results of the equipment's operation can then be obtained.

2.1.4 Expert System

The application of expert systems can solve the complex problems that exist in intelligent manufacturing and bring expert systems into the field of intelligent manufacturing. This can effectively ensure the efficient implementation of various decisions. In the actual manufacturing process, the timing information generated during the manufacturing process can be processed. For example, real-time feedback on equipment operation and a comprehensive understanding of problems, as well as early warning, rapid problem identification, and diagnosis in the system, can provide

manufacturing enterprises with better operational plans. Based on a study of the characteristics of manufacturing process failures, the method of failure identification using a fuzzy clustering algorithm can accurately detect failure signals, thereby improving the efficiency of the manufacturing process.

2.1.5 Robotics

Intelligent robots mainly encompass the functions of biometrics, deep learning, sensors, and brakes. Manufacturing enterprises can utilize robot technology to independently perform and process tasks, in conjunction with the work of operators. This allows for flexible handling of various tasks, ultimately leading to a significant improvement in manufacturing efficiency.

2.2 Intelligent manufacturing systems

Intelligent Manufacturing System includes a machining center, CNC lathe, industrial robot, master control cabinet, MES system, stereo warehouse, RFID (radio frequency identification technology), etc. Through the MT4620TE man-machine dialogue interface, the whole process of real-time monitoring and manual adjustment. PLC from Siemens S7-1200 PLC to complete the whole system data collection and processing, and through PLC will be three-dimensional warehouse positioning information to an industrial robot there, from which to complete the material extraction, and through the machining center or CNC signal exchange to complete the material handling and handling operations. The RFID chooses Siemens 300 General Company, uses for the RFID reader and the writer, and uses the RS-485 protocol to connect with the PLC, which may read and write to the workpiece RFID, when the RFID is read out, the workpiece RFID data will be transmitted to the CNC machine, and then the CNC programming into the CNC machine. For example, the manipulator of a manufacturing enterprise adopts Guangzhou CNCGSKRB20 manipulator, which is mainly used to process the parts in the 3D material warehouse on CNC, then the CNC parts are put into the 3D material warehouse. In addition, the industrial robot fetches material from the three-dimensional warehouse, mainly through the external axis movement, and carries on the feeding and the cutting processing to the numerical control machine tool, after the numerical control machine tool finishes the processing, takes out the material, and put it back in the warehouse. The whole process is automated, without human intervention, which is very helpful to improve manufacturing efficiency and product quality, but also can effectively reduce human resource consumption.

3. Application suggestion of intelligent manufacturing technology and system

To promote the development of intelligent manufacturing, which is a relatively large and systematic project involving long-term cooperation among multiple parties. For this reason, the manufacturing industry should base its actions on the present situation, focus on long-term goals, and carry out comprehensive planning and top-level design. This should be done in close alignment with the manufacturing industry development strategy. Research should be conducted to propose measures that promote the path to intelligent manufacturing and ensure its success. Specifically, the following steps should be taken:

3.1 Construct the top-level planning of intelligent manufacturing and establish the standard system of intelligent manufacturing

After summarizing the characteristics of design, manufacture, and management of manufacturing enterprises, this paper analyzes the connotation and characteristics of intelligent manufacturing enterprises. It focuses on key technologies, business and process flows, and manifestations. The top-level design of intelligent manufacturing should be well-executed, taking into account the current state of the manufacturing process and the development goals of intelligent manufacturing. This involves constructing the overall structure of the intelligent manufacturing enterprise at various levels, including the infrastructure layer, control layer, executive layer, application layer, and management layer. At the same time, it should be based on the guidelines of the National Intelligent Manufacturing Standard system construction. According to the actual situation and characteristics of manufacturing enterprises, we will further promote the application of smart equipment, smart factories, smart services, manufacturing software, and big data. We will integrate key technology standards for smart manufacturing and determine the application of key technologies in the manufacturing industry. We will also develop a standard working system that provides reference for intelligent manufacturing workshops, Equipment Information Integration Standards, intelligent decision-making, and control technology for manufacturing processes. This will effectively promote the development of intelligent

manufacturing enterprises. According to the specific design technology requirements of intelligent manufacturing, such as 3D design and simulation technology innovation, intelligent manufacturing enterprises should adhere to industry standards. These standards include the manufacturing material code specification, manufacturing Cloud Platform Interface Specification, manufacturing software and big data standards, manufacturing software integration, manufacturing big data processing technology, and data management needs.

3.2 Strengthening the construction of intelligent manufacturing equipment

If you want to truly achieve intelligent manufacturing, professional knowledge and software and hardware technology should be organic integration. The core technology of intelligent manufacturing is intelligent design, intelligent manufacturing, intelligent management and control, and integrated application of big data, focusing on the development of intelligent equipment in the field of manufacturing, intelligent manufacturing system integration, digital workshop and intelligent factory integrated solutions and other core and common technology breakthroughs, it is helpful to improve the manufacturing quality of intelligent equipment and realize the intelligent integration of production line, workshop and factory. Therefore, it is very important to strengthen the construction and application of intelligent manufacturing equipment in order to promote the intelligent development of manufacturing design, process, management and service. Manufacturing Enterprises should integrate and optimize PDM, ERP, MES and PLM systems to open up the information channels among design, manufacturing, management and service, Accelerate the popularization and use of product life cycle management, customer relationship management, supply chain management, remote operation and maintenance services, finally achieve the design and manufacturing, management and operation of important links of information integration and optimization purposes. For example: Research and development of manufacturing integration collaborative platform, 3D detailed design audit system, 2D schematic driven 3D model generation software, 3D design intelligent process knowledge base, 3D work visualization guidance system, product data management system for intelligent manufacturing, etc. In intelligent manufacturing, taking the cutting, forming, welding, painting and grinding of the parts of the manufacturing body as an example, while focusing on the basic processes of cutting, forming, welding, painting and grinding of the parts, the use of automation and intelligent equipment technology to break through the measurement sensors, visual sensors, data acquisition system (SCADA) and other integrated applications in manufacturing equipment and intelligent assembly line, Relying on technologies such as special intelligent manufacturing equipment, grinding robots, high-power Laser-hybrid welding, and intelligent assembly line manufacturing, and with parts detection and assembly, logistics and warehouse management effectively integrated to achieve the entire process of intelligent manufacturing development.

3.3 To perfect the construction of an intelligent manufacturing line and realize the integrated innovation and application of intelligent manufacturing

To promote the development of the intelligent manufacturing industry, it is necessary to establish a dynamic data sensing system based on a distributed sensor network and IOT system in the workshop, ensure design, manufacturing, logistics, management, and service information and data integration, to achieve the manufacturing process, “Parts, equipment, space and people” full connectivity. To promote the innovation and upgrade of intelligent manufacturing engineering, we should construct a standard system of intelligent manufacturing and an information security system. In light of the imperfections in the current intelligent construction of manufacturing workshops and the low level of digitalization, it is important to conduct in-depth research on the general model of Manufacturing Intelligent Workshop, the segmentation of manufacturing processes, the design of intelligent workshop systems for pipes and coatings, the design and integration of verification platforms, and the establishment of workshop solutions. This research will also provide guidance for the design and integration of intelligent management and control systems on the shop floor, the design and integration of intelligent manufacturing production lines, and the development of basic platforms for intelligent manufacturing on the shop floor. Ultimately, this research is of practical significance in promoting the development of intelligent manufacturing in manufacturing enterprises.

4. Conclusion

To sum up, actively promoting the deep integration of the new generation of information technology and manufacturing enterprises is crucial for achieving automation, digitalization, and intelligentization of the manufacturing process. This integration relies on intelligent and digital technologies to transform the manufacturing process into a

data-driven model of manufacturing intelligence. Therefore, we should rely on intelligent manufacturing technology to enhance the operations of manufacturing enterprises. Simultaneously, this will facilitate industrial upgrading and establish a solid foundation for the development of our manufacturing industry.

References

[1] Xu Yi. Development of Intelligent Manufacturing Execution System Technology and construction and application of industrial software platform [J]. Network security and informatization, 2023(08): 101-104.

[2] Wei Changyou. The application and development trend of PLC Technology in mechanical engineering control system under the background of intelligent manufacturing era [J]. China Equipment Engineering, 2022(24): 219-221.

[3] Zhou Jianglin, Zhang Bo, Kong Xiangjun, et al. Development of Intelligent Manufacturing Execution System Technology and construction of industrial software platform [J]. Intelligent Manufacturing, 2022(02): 62-66.

[4] Li Yang. Feasibility Study of intelligent manufacturing technology and system in machining field [J]. Internal combustion engines and accessories, 2021(13): 184-185.

[5] Wang Yang, Zhu Xiaoping. Development and research of intelligent manufacturing technology and systems [J]. Journal of Chifeng College (Chinese philosophy and social sciences edition), 2020, 41(08): 53-57.