Exploration and Practice of Intelligent Manufacturing Reform in Motor Industry under the Background of Made in China 2025

Lizhen Hu[*]

Huzhou Vocational and Technical College, Wuxing, Huzhou, Zhejiang, China
[*]*Corresponding author*

Keywords: Made in China 2025, intelligent manufacturing, motor, manufacturing, trend of development

Abstract: With the introduction of favorable policies for intelligent manufacturing in China, more and more Chinese enterprises invest in the field of intelligent manufacturing. However, in addition to the intelligent manufacturing of a single industry such as automobiles to promote the development of the whole industry, other industries, especially small and medium-sized manufacturing, its industry 4.0(intelligent) is still in the concept and demonstration stage, has not been applied in practice, and there are still many problems in the process of promotion. Under the background of "Made in China 2025", based on the analysis of the current situation and development trend of intelligent manufacturing in the traditional motor industry, the advantages of intelligent manufacturing and intelligent manufacturing promotion errors are clarified, and the contents and strategies of intelligent manufacturing reform are explored to provide support for the development of small and medium-sized motor industry.

1. Introduction

With the increasing innovation of information technology, the transformation and upgrading of the manufacturing industry is imminent. In order to lead a new round of manufacturing revolution, Made in China 2025 describes the grand blueprint of building a strong manufacturing country from the national strategic level for the first time, and intelligent manufacturing has gradually become the core of today's manufacturing development [1].

Under the background that motor performance and labor cost are gradually increasing, and that the consumption reduction and efficiency improvement of traditional manufacturing mode and design have almost reached the limit, we should reduce the total consumption of resources and energy in manufacturing industry, improve utilization efficiency, promote the development of green equipment manufacturing industry, and promote the technological transformation of enterprises [2]. Promoting motor intelligent manufacturing and developing new technology suitable for motor intelligent manufacturing are important ways to improve the performance and efficiency of motor products.

Based on the introduction of the current situation of motor manufacturing and the

misunderstanding of intelligent manufacturing promotion, this paper explores and practices the reform content and ideas of intelligent manufacturing in the motor industry, and then provides references for motor enterprises to carry out intelligent manufacturing engineering construction, carry out overall planning of intelligent manufacturing, and accelerate the pace of industrial transformation and development [3].

2. Current Situation and Development Trend of Motor Intelligent Manufacturing

Since June 1, 2021, the new national standard of motor GB18613-2020 has been officially implemented, and the energy efficiency motor below IE3 has been forced to stop production and sell. It can be said that the domestic motor industry has fully entered the era of high efficiency motor. At present, under the influence of the COVID-19 pandemic and the sharp rise in material prices, the competition in the domestic motor market will become more and more fierce, and the demand for multi-variety, small-batch and fine motor will become more and more dominant. Customers have higher and higher requirements for motor customization, and the traditional production mode will not be able to meet the growing market requirements. The transformation to intelligent manufacturing is the inevitable trend of the development of the motor industry [4].

In recent years, our motor industry continues to transform and upgrade to digital and intelligent. It has become an industry consensus to increase the construction of new production bases and increase the investment in advanced production lines, digital and intelligent equipment [5]. Some enterprises are doing very well, while some enterprises have not changed much in nature. I think the development of intelligent manufacturing in the domestic motor industry is still in the initial acceleration stage. It is mainly reflected in the following aspects:

(1) At present, the motor has entered the era of IE3, and the market requirements for motor performance will continue to improve. Under the requirements of higher energy efficiency standards, the development of intelligent manufacturing needs to match the whole process control of design, technology, information, processing accuracy and quality, which is mainly based on the enterprise's own exploration.

(2) Most enterprises in the motor manufacturing industry chain are still in the middle and downstream industrialization level. For example, standard parts suppliers and casting suppliers are still in the stage of industry 2.0 or even industry 1.0, and the intelligent development cannot connect with advanced enterprises.

(3) Intelligent manufacturing focuses on "intelligence", which includes intelligent manufacturing technology and intelligent manufacturing system. Intelligent manufacturing is not only to realize the interaction between advanced equipment and people. According to the characteristics of the enterprise and; Features, advanced information technology and manufacturing technology to achieve a deep integration, is still our current need to think. In short, compared with industries such as semiconductors and automobiles, intelligent manufacturing in the electric motor industry started late and is still mostly in the initial stage.

3. Errors in the Process of Motor Intelligent Manufacturing

3.1. Cognitive Errors

Some enterprises think that the introduction of some advanced equipment, the introduction of ERP, MES management system, can realize online ordering, dispatching, warehousing and other processes is intelligent manufacturing. The technical and management personnel of the enterprise are too little involved in the process of technical reform, and most things are handed over to others. This way of doing things is a cognitive error [6].

3.2. Not Planning Properly

An enterprise technology investment is insufficient, or rely on the original facilities, workshop, warehouse, assembly line layout, business process, logistics road. Line, network communication line design, in the overall layout of the overall reasonable planning, repeated optimization.

3.3. Bottlenecks in the Equipment Industry

Manufacturing in the final analysis depends on machine tools and other sophisticated equipment and scientific process guarantee, and at present many domestic equipment technical accuracy and information and developed countries in Europe and the United States is still a certain gap, unable to match the requirements of intelligent manufacturing for equipment.

3.4. The Blindness of Choosing Information Management System

Because some motor enterprises do not know what the information system can do, they do not know what management system they need, and some even do not have sufficient research, they will only choose the expensive one and not the right one, and there is a certain blindness in the choice of management system.

3.5. Lack of Talent

The shortage of technical development talents, information management talents, equipment maintenance and management personnel is often a common problem encountered by many manufacturing enterprises.

4. Intelligent Manufacturing Promotion Content and Strategy

4.1. Construction Method of Digital Motor Workshop/Intelligent Factory

4.1.1. Construction Ideas of Digital Motor Workshop/Intelligent Factory

The construction task of the motor intelligent manufacturing platform is divided into two parts: hardware construction and information system construction. The main work content of the hardware part is to build digital production lines covering the whole process of motor manufacturing, including stamping, metalworking and final assembly. The part of information system construction mainly includes PLM, ERP and MES three systems as the core, including WMS, energy efficiency management and remote data maintenance interconnection system construction, to build the whole life cycle of the motor operation platform [7].

4.1.2. Construction Method of Digital Motor Workshop/Intelligent Factory

(1) Conduct a comprehensive evaluation of the enterprise to be transformed, including product type, market positioning, production and business mode, understand the coverage and demand, and carry out the overall structure design.

(2) Starting from the research and determination of process model, the digital model of product and production flow is established.

(3) Carry out product process planning and verification, digital factory modeling and operation simulation, and try to carry out model research and simulation of digital production line by means of unit.

(4) Make an overall plan for information construction, including the PLM system construction and process management as the basis, refining the business process with MES as the core, building traceable quality solutions, and the allocation and optimization of manufacturing resources.

(5) Build an information management system with data connectivity as the key elements, including WMS, energy efficiency management and remote data maintenance, and build the operation mode of the whole life cycle of the motor.

4.2. Key Points of Digital Workshop Information Planning and Design and System Integration Construction

(1) We will make overall plans for IT application. It is necessary to make overall planning of different levels of management system supported by different data and information tools with the participation of different users, and pay attention to different requirements of data upload, delivery and interaction in the overall planning.

(2) Based on PLM system construction and process management, The classification of all basic data such as design BOM/ manufacturing BOM data, structural design (parts, technical documents, two-dimensional drawings, three-dimensional drawings) files, electrical design (component drawings, schematic diagrams, etc.) files, process design (procedures, tooling, equipment, materials, process cards, process cards) data templates, ECN changes, non-ECN changes, change guidance, etc., warehouse construction and circulation requirements.

(3) Refine the business process with MES as the core, and create personalized MES system suitable for their own production mode.

(4) Build positive or negative traceability quality solutions.

(5) Allocate and optimize manufacturing resources. All the materials in the manufacturing process were classified, and the optimal supply chain model under different constraints was optimized by mathematical method until the optimal configuration scheme was found.

Through the above steps, we can find out the difficulties and needs of enterprise informational construction. According to these needs, we should first build the basic informational system according to the strategy of "planning once and implementing step by step". At the same time, we should not only train the management personnel of the informational system, but also train the operation staff of the workshop to use the informational system. Then, it builds subsystems with PLM, ERP and MES system as the core, data interconnection as the means, and later supplement such as human resource management, supply chain management and other independent modules, and finally completes the comprehensive information management platform that can meet the hierarchical needs of managers and implements at all levels.

5. National Intelligent Manufacturing New Mode Application Project

Taking Jiangsu medium and large project as an example, the motor intelligent system is analyzed in detail. Jiangsu Dazhong started the overall planning of intelligent manufacturing in 2016, and officially completed the motor digital manufacturing plant on May 18, 2019.The specific practice of its intelligent manufacturing is as follows [8]:

5.1. Application of New Mode of Intelligent Manufacturing

By studying the key parameters such as product type, capacity and process of existing factories, the overall design of the digital workshop of high efficiency motor was carried out, the digital modeling was carried out for the flexible tooling units of gold processing, stamping, winding core and whole machine assembly, and the overall modeling of the digital workshop was established [9].

At the same time, the existing process was studied, and the production line and processing unit of intelligent manufacturing were combined to determine the new process flow. In addition, MES, ERP, WMS, PLM and other information systems of the factory are integrated to realize the interconnection of the whole system of the digital workshop.

5.2. Network Architecture and Information Models

According to the demand of producing ultra-efficient and energy-saving motors, a four-layer network architecture is established from the bottom up, which is divided into equipment layer, control layer, management layer and enterprise layer. By optimizing the process flow, the motor digital shop information model was determined. The information model was composed of static attribute set, process attribute set, configuration attribute set and shop set.

5.3. Production Management and Simulation Verification

Set up ultra-efficient motor full life cycle system (PLM), product data management system based on power profile spectrum, product development and simulation platform (CAD, CAPP, CAE and CAM) and product data management platform (PDM) to centrally manage product data related to design and development. And according to the different frame size, power, pole number and other spectral information of the product classification management. Products and parts are digitally modeled, and prototypes are analyzed and optimized to form 3D printed documents. At the same time, the model is monitored to verify the feasibility of the design scheme, and reasonable suggestions are put forward to improve the reliability of the actual production system implementation.

5.4. Manufacturing Process Planning and Data Visualization

Through the study of intelligent manufacturing equipment and technology, the motor manufacturing process planning, based on SCADA software related equipment and instrument data collection and sorting, using MES system for display and monitoring [10]. After data integration of MES system with ERP, PLM and other systems, advanced scheduling can be carried out. The production plan can be queried through the station terminal on site, and the station terminal can change, receive and store the production plan according to the business process, so as to realize pull production.

5.5. Stamping Workshop and Production Line Construction

Carry out the development and application of intelligent core equipment such as motor fixed rotor, digital wiring, AGV, RGV, high-speed sorting, quality inspection, etc., build 2 digital stamping production lines, 7 winding core production lines, 12 gold processing production lines, 6 complete machine assembly and other workshop production lines. And the use of RGV/AGV, stacker, unmanned laser forklift, industrial control operation terminal and logistics management system (WMS) and other technical equipment to achieve from wiring, assembly to finished products unmanned logistics operations.

6. Conclusion

The government should continue to play the leading role of standards, supervision and restraint, improve the formulation of standards under the guidance of relevant national policies, and more

importantly, the implementation of standards. With the guidance of standards, the government should increase the pressure on enterprises, strengthen supervision, and provide a good market environment for the improvement of energy efficiency of motor systems. Implement the transformation of motor system by field and industry. Combined with the characteristics of each industry, the characteristics of each enterprise, with a focus on promoting. We should understand the characteristics of each industry, formulate appropriate and applicable transformation plans according to the characteristics of each industry, and carry out special promotion work in different fields. In accordance with the requirements of Premier, "mass entrepreneurship and innovation", innovation is the fundamental driving the development of manufacturing industry, the efficient promotion of motor core is technological innovation, vigorously encourage and support enterprise innovation. Only the continuous progress of technology is the market continues to drive.

Acknowledgements

References

[1] Yang Jiming. (2012) Thinking and Countermeasures of Transformation and Upgrading of Private Motor Manufacturing Enterprises. Industry and Technology Forum, 11 (6): 14.

[2] Li Zhuo, Li Yuanqi. (2020) Development Status of Intelligent Manufacturing and International Experience Reference. Contemporary Economy, (9): 70.

[3] Zeng Guangfeng. (2020), Present situation and Trend of Intelligent Manufacturing Industry in Our Country. Quality and Certification, (11): 46.

[4] Mitsubishi Electric Automation (China) Co., LTD. (2020) Digital Transformation for Intelligent Manufacturing. Electric Age, (7): 21.

[5] Meng Fansheng, Zhao Gang. (2018) Research on Influencing Factors of Development from Traditional Manufacturing to Intelligent Manufacturing. Science and Technology Progress and Countermeasures, 35 (1): 66.

[6] Zhou Ji. (2015) Intelligent Manufacturing: The Main Direction of "Made in China 2025" China Mechanical Engineering, 26 (17): 2273.

[7] Kong Fanguo, Yu Wenxiao. (2020) Development Status and Trend of Intelligent Manufacturing. Mechanical Engineer, (4): 4.

[8] Gong Yuanding. (2007) Current Situation and Development Trend of Micromotor Manufacturing Technology. Micromotor, 40 (8): 72.

[9] Zhao Yong. (2019) Research on Improved Processing Technology of Shaft Material in Motor Intelligent Manufacturing. Heilongjiang Science, 10(20): 104.

[10] Wang Fengying. (2017) Field Analysis and Improvement of Final Assembly Workshop of Nanhua Electric Machine Factory. Science and Technology Information, 15 (27): 54.