Discussion on the Innovation and Transformation of IMM and Processing Mode

Miao He*
College of New Energy Vehicle, Nanchang Institute of Science and Technology, Nanchang, Jiangxi, China
*Corresponding author e-mail: hemiao@nut.edu.cn

Abstract. The progress of manufacturing is the driving force and foundation of social development, and the manufacturing industry represents the country's production level and comprehensive strength. With the continuous development and advancement of science and technology, intelligent manufacturing has transformed the traditional labor-intensive manufacturing model, which can optimize the production management process of the enterprise to a large extent and reduce the manufacturing cost. This article aims to explore the innovative transformation of intelligent machinery manufacturing (IMM) and processing models. This article first analyzes the current situation of my country's manufacturing industry to promote intelligent manufacturing, and points out the problems that exist in the development process. Based on existing problems, this paper takes manufacturing company H as an example, through questionnaire surveys and actual research methods, explores the advantages of H company in the development of intelligent manufacturing, and finally puts forward the promotion of intelligent manufacturing capabilities and intelligent processing in the manufacturing industry. The survey data shows that among 212 people, 140 people think that H company has a clear intelligent manufacturing plan, 152 people think that the company's human-machine cooperation is efficient, and 157 people think that the company's production equipment technology is perfect. This shows that the advantages of H Company's production process are: clear goals in the intelligent manufacturing transformation plan, better business cooperation between various departments, perfect management of standardized operations in the workshop, higher coverage of automation equipment, and better human-machine coordination capabilities.

Keywords: Intelligent Manufacturing, Processing Mode, Innovation and Transformation, Equipment Manufacturing

1 Introduction
Manufacturing is the source of social progress and a concentrated expression of historical development. With the continuous advancement of science and technology, manufacturing has also been continuously improved, transforming to intelligent manufacturing [1, 2]. Intelligent
manufacturing uses equipment, production lines, workshops, factories and other physical carriers to digitize and network traditional manufacturing to form an adaptive, flexible, visualized and integrated intelligent manufacturing environment [3, 4]. Realize the shortening of product development cycle, the reduction of resource consumption, the improvement of production efficiency, the further improvement of product quality, and the overall enhancement of the competitiveness of enterprises [5, 6]. Chinese manufacturing enterprises are facing huge challenges and opportunities in the process of industrial transformation and upgrading. How to maintain the advantages of China's manufacturing powers needs to do something in the innovative transformation of IMM and processing modes [7, 8].

Regarding the research of intelligent manufacturing, many scholars have discussed in different aspects. For example, Qiao F proposed that intelligent manufacturing is a kind of integration of automation, flexibility and integration by closely integrating the manufacturing capabilities and information capabilities of enterprises. An advanced manufacturing model integrated with intelligence [9]; Abuhasel K A pointed out that China’s manufacturing industry is neither driven by software like the United States nor driven by its own powerful manufacturing equipment like Germany. Therefore, it cannot fully refer to the development models of other developed manufacturing countries [10].

This article aims to explore the innovative transformation of IMM and processing modes. This article first analyzes the current situation of my country's manufacturing industry to promote intelligent manufacturing, and points out the problems that exist in the development process. Based on existing problems, this paper takes manufacturing company H as an example, through questionnaire surveys and actual research methods, explores the advantages of H company in the development of intelligent manufacturing, and finally puts forward the promotion of intelligent manufacturing capabilities and intelligent processing in the manufacturing industry.

2 Discussion on the Innovation and Transformation of IMM and Processing Modes

2.1 Status Quo and Existing Problems of IMM and Processing Modes

(1) Product development and manufacturing are not synergistic

Many manufacturing companies use manual control throughout the product development process. Product management does not accept centralized control of the system. There is no practical inspection during research and development, and it is out of touch with actual production. Frequently, the products developed are not technically compatible with mass production requirements. It is consistent, the rectification is made while making mistakes in the production process, which greatly affects the production schedule and product quality [11, 12]. In addition, the technical process has not been electronic, and the transmission is completed through paper materials, and the phenomenon of incoordination is becoming more and more serious.

(2) The system integration is not high

The collection of various systems has not been fully automated, and some information needs to be manually summarized and processed manually. The result is that people are not operating the operating system, but people are used as auxiliary tools to cooperate with the system. In addition, the collection and exchange of data and information between each link of the system is not smooth.

(3) Insufficient manufacturing technology of intelligent machinery

Market demand is the driving force, and technological development is the guarantee. For enterprises, intelligent manufacturing must be trending through the improvement of business capabilities and the significant improvement of market competitiveness. At the same time, enterprises are required to have strong technical support as a guarantee during the implementation process.

The manufacturing upgrade implemented in the manufacturing industry is a cluster of advanced equipment that integrates machinery, electronics, automatic control, and informatization, with a high degree of automation and high integration. Due to the large number of design technology fields and strong technical relevance, the implementation of smart manufacturing by enterprises is increased. There is a risk that the development of the project will be hindered due to insufficient technology.
(4) Outdated management model

For a long time, many manufacturing companies' decisions, especially major decisions, need to be reported and approved at various levels. The company's production and management processes are lengthy and cumbersome, with multiple levels, and the lack of timely and effective affirmation and decision-making of innovative ideas has delayed the process of corporate technological innovation and has become a stumbling block on the road to innovation. For example, a decision on science and technology is reported to the head of the company by the science and technology quality department or the production unit, and the head of the company reports to the general manager of the company, and then submits it to the general manager's office for discussion and approval. After the proposal is approved, it needs to be reported to the company’s headquarters. For examination and approval, major decisions need to be reported to the group company for approval and approval before they can be carried out. Such a long management chain has left enterprises lacking sufficient autonomy and lost many opportunities. It has also made enterprises increasingly passive and lacking in vitality. To some extent, this management model has seriously hindered the development of enterprise technological innovation, which is also a common problem of manufacturing enterprises.

2.2 Countermeasures for the Innovative Transformation of IMM and Processing Models

(1) Attach importance to the improvement of product competitiveness and cultivate the spirit of innovation

Regardless of whether an enterprise adopts an incremental or abrupt innovation model at any stage, it requires in-depth analysis and research on the preconditions and interrelationships of its product competitiveness. One is to increase research on the index system of innovation models. Talent is the foundation of the innovation model indicator system. It is necessary to further rationally allocate human resources, give full play to the advantages of talents, and actively create space and guarantee for enterprise technological innovation. The second is to strengthen the analysis of prerequisites. The current product management industry is showing a diversified trend. To achieve the goal of low investment and quicker results in the production and operation of enterprises, it is necessary to weigh the balance between people, resources, and basic capabilities. Through the role of company policy tilt and innovation leadership, promote scientific and technological talents to give full play to their technical capabilities, and achieve dual synchronization of product innovation and efficiency creation.

(2) Optimize the allocation of existing resources

By optimizing the organization and the integration of technical resources, first ensure that the company-level technical advantages are strengthened, establish a technology quality center, and realize the concentration of superior technical resources to solve company-level new product research and development, technical research, scientific and technological projects, process improvements, equipment upgrades, and technical support work; in the production line, concentrate on doing daily technical management, equipment maintenance, production operation, and new technology application work, maximize the two-level enthusiasm, enhance the company’s innovation capabilities, so that the independent management model can be better applied and made Give full play to a greater advantage.

(3) Establish an innovation team

The first is to create conditions to promote research personnel to do research and development in the factory, and use technical experts as research and development (R&D) project managers. Led by technical experts in the enterprise, a team is formed to carry out technical research and give full play to the leading role of enterprise technical experts in technology research and development. For major R&D or technological transformation projects, technical experts are publicly appointed as project leaders within the company. The project team is composed of research institute personnel and technical personnel to fully mobilize the enthusiasm and creativity of various R&D personnel and technical personnel, and give full play to their technical expertise.

The second is to accelerate the cultivation of innovative talents and increase the introduction of high-level talents. On the basis of giving full play to the role of existing talents, focusing on the urgently needed high-level talents of the company, breaking the restrictions on the establishment,
facing the whole country, accurately introducing a group of high-end talents, and providing preferential policies such as salary and housing subsidies, as well as talent training and Incentive policies such as career development planning, honor incentives, work incentives, emotional care, etc. attract and retain talent.

The fourth is to strengthen two-way exchanges between scientific and technological personnel at all levels. Actively explore the annual exchange work between R&D personnel and technical personnel, so that R&D personnel understand the production process and process, and enable production unit technical personnel to understand the R&D process, form a new situation in which all employees participate in scientific research, and cultivate the comprehensive ability of R&D personnel and technical personnel.

(4) Consolidate technical support

Give full play to the power of experts, organize the company's technical experts to establish a technical diagnosis team, solve various practical problems encountered by the production unit, accumulate technical experience, and improve the innovation ability of technical experts. At the same time, it is necessary to give full play to and mobilize the enthusiasm of enterprise technical experts, establish an expert technical diagnosis team, and solve production technical bottlenecks and problems. The science and technology quality department regularly organizes technical exchanges and training, communicates with R&D personnel and technical personnel, strengthens personnel training, and promotes continuous improvement of personnel.

2.3 Calculation of Elements of IMM Capacity

Productivity is the basis for the survival of an enterprise, and productivity calculation elements can be used to build a basic calculation model for studying whether the production capacity of an enterprise is improved. Due to the large variety of manufacturing enterprises, the manufacturing processes of different types of enterprises are very different. Therefore, before calculating the production capacity of a certain enterprise, it is necessary to determine the production type and the measurement unit of the production capacity of the enterprise.

(1) Calculate the capacity of a single device
Calculated as follows:
\[ H_e = H_0 \times \eta = H_0(1 - \theta) = F_0 - S \]  

\( H_0 \) represents the annual system working time; \( \eta \) represents the planned utilization of the equipment system working time; \( \theta \) represents the planned repair shutdown rate of the equipment; \( S \) represents the planned repair shutdown time of the equipment.

(2) Calculate the production capacity of the pipeline company

The production capacity of the assembly line depends on the production capacity of the equipment in each process, so the calculation starts from a single piece of equipment. Calculated as follows:
\[ M_e = H_e / t_i \]

\( M_e \) indicates the production capacity of a single piece of equipment; \( H_e \) indicates the effective working time (hours) of the single piece of equipment planning period (year); \( t_i \) indicates the time quota (hours/piece) for a single product to be processed on the equipment. If the process is undertaken by a piece of equipment, the production capacity of a single piece of equipment is the process capability. When the process is undertaken by N equipment, the process production capacity is \( M_e \times N \).

3 Experimental Research on the Innovation and Transformation of IMM and Processing Modes

3.1 Research Methods
(1) Field and questionnaire survey method
In order to fully grasp the development status of intelligent manufacturing of H company, research activities are carried out among government officials, experts and scholars from universities and scientific research institutions, and main leaders and staff of the company through visits and surveys and questionnaires.

3.2 Questionnaire Design
The goal of the questionnaire or interview survey is to clarify the current situation and needs of the research objects, and promote the improvement and optimization of research. This survey was conducted in the form of a questionnaire. The survey subjects selected 20 employees from various departments responsible for production in Company H, including the R&D department, integrated business department, technical department, finance department, and marketing department, to conduct interviews.

3.3 Questionnaire Issuance and Collection
A total of 230 questionnaires were distributed in the experiment, 210 and 20 online survey questionnaires and 20 on-site survey questionnaires were distributed. A total of 212 questionnaires were returned, including 204 online survey questionnaires and 18 on-site survey questionnaires.

4 Data Analysis of the Discussion on the Innovation and Transformation of IMM and Processing Modes

4.1 Advantages of H Company's Production Process
Table 1 is the result of the survey on the advantages of the production process of H company: out of 212 people, 140 people think that H company has a clear intelligent manufacturing plan, 139 people think that the department’s organizational responsibilities are clear, and 152 people think that the company’s human-machine cooperation efficiency High, 157 people think that the company’s production equipment technology is perfect.

Table 1. Advantages of H Company’s production process

| Advantage                                      | Absolutely disagree | Disagree | Basically agree | Totally agree |
|-----------------------------------------------|---------------------|----------|-----------------|---------------|
| A. Clear and clear smart manufacturing planning | 7                   | 21       | 44              | 140           |
| B. Department organization responsibilities are clear | 15                  | 12       | 46              | 139           |
| C. High efficiency of human-machine cooperation | 9                   | 14       | 37              | 152           |
| D. Perfect production equipment technology     | 16                  | 14       | 25              | 157           |

It can be concluded from Figure 1 that the advantages of H company's production process are: clear goals in intelligent manufacturing transformation planning, clear responsibilities of each department, good business cooperation between each department, perfect management of standardized operations.
in the workshop, the coverage rate of automation equipment is high, the man-machine coordination ability is good, and there is no difficulty in human operation.

4.2 Problems Existing in H Company's Machinery Manufacturing and Processing Mode

Sorting out the problems existing in the H Company’s machinery manufacturing and processing model, the results are shown in Table 2. Among 212 people, 79 people think that the company’s information management system is not perfect, 64 people think that the company’s productivity is low, and 75 people think that the company’s productivity is low. The informatization data set is low, and 71 people think that the company's talent training model needs to be improved.

Table 2. Problems

| Problem                        | Absolutely disagree | Disagree | Basically agree | Totally agree |
|--------------------------------|---------------------|----------|-----------------|---------------|
| A. Information management system | 79                  | 62       | 45              | 26            |
| B. Strong productivity         | 64                  | 69       | 47              | 32            |
| C. Information data collection | 75                  | 67       | 40              | 30            |
| D. Professional talent training model | 71                  | 52       | 64              | 25            |

Through field research, it is found that because H Company currently has not many customers with stable cooperation and the number of orders is also small, the company’s existing production efficiency is sufficient to meet monthly orders, but overall, the company’s daily output is small and does not too stable and low productivity.

5 Conclusion

The rapid development of science and technology has created conditions for traditional enterprises to change their manufacturing and business models. For traditional manufacturing, a single-mode production technology can no longer meet the needs of technology and the market. Only by closely combining informatization, networking, and intelligence with manufacturing can traditional manufacturing companies gain a new round of information technology. This article discusses the innovative transformation of IMM and processing models. This article first analyzes the current situation of my country's manufacturing industry to promote intelligent manufacturing, and points out the problems that exist in the development process. Based on existing problems, this paper takes manufacturing company H as an example, through questionnaire surveys and actual research methods, explores the advantages of H company in the development of intelligent manufacturing, and finally puts forward the promotion of intelligent manufacturing capabilities and intelligent processing in the manufacturing industry.
Acknowledgements
This work was supported by Scientific Research Project Fund of Jiangxi Province (No.GJJ181054).

References
[1] Thoben K D, Wiesner S, Wuest T. "Industrie 4.0" and Smart Manufacturing – A Review of Research Issues and Application Examples. International Journal of Automation Technology, 2017, 11(1):4-19.
[2] Yin L, Luo J, Luo H. Tasks Scheduling and Resource Allocation in Fog Computing Based on Containers for Smart Manufacturing. IEEE Transactions on Industrial Informatics, 2018, PP (10):1-1.
[3] Herwan J, Kano S, Oleg R, et al. Comparing Vibration Sensor Positions in CNC Turning for a Feasible Application in Smart Manufacturing System. International Journal of Automation Technology, 2018, 12(3):282-289.
[4] MJ Vila-Gutiérrez, F Aguayo-González, Lama-Ruiz J R. Framework for the Development of Affective and Smart Manufacturing Systems Using Sensorised Surrogate Models. Sensors, 2021, 21(7):2274.
[5] Chang, Wook, Kang, et al. Effect of inspection performance in smart manufacturing system based on human quality control system. The International Journal of Advanced Manufacturing Technology, 2018, 94(9-12):4351-4364.
[6] Lalanda P, Morand D, Chollet S. Autonomic Mediation Middleware for Smart Manufacturing. IEEE internet computing, 2017, 21(1):32-39.
[7] Lee C, Park L, Cho S. Light-Weight Stackelberg Game Theoretic Demand Response Scheme for Massive Smart Manufacturing Systems. IEEE Access, 2018, PP (99):1-1.
[8] Dey B K, Bhuniya S, Sarkar B. Involvement of controllable lead time and variable demand for a smart manufacturing system under a supply chain management. Expert Systems with Applications, 2021(2):115464.
[9] Qiao F, Liu J, Ma Y. Industrial big-data-driven and CPS-based adaptive production scheduling for smart manufacturing. International Journal of Production Research, 2020(3):1-21.
[10] Abuhasel K A, Khan M A. A Secure Industrial Internet of Things (IIoT) Framework for Resource Management in Smart Manufacturing. IEEE Access, 2020, PP (99):1-1.
[11] Kim D, Park B J, Moon J, et al. Design and Performance Analysis for Edge Intelligence-Based F-PMIPv6 Mobility Support for Smart Manufacturing. Wireless Communications and Mobile Computing, 2021, 2021(20):1-14.
[12] Yang B, J Zhang, Shi H. Interactive-Imitation-Based Distributed Coordination Scheme for Smart Manufacturing. IEEE Transactions on Industrial Informatics, 2020, PP (99):1-1.