Smart manufacturing in E-commerce and its implications for business operations management

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Abstract. The development of intelligent manufacturing is facing many opportunities and challenges. Operation management is the third major content of enterprise management in addition to financial management and marketing management, and intelligent manufacturing is a production method that has emerged with the development of science and technology. With the development in recent years, the impact of intelligent manufacturing on enterprise production and operation management has gradually appeared. The article combs the impact of intelligent manufacturing on production and operation management, to provide reference for the subsequent production and operation management. The development of intelligent manufacturing requires close cooperation among the government, enterprises and all sectors of society to improve the knowledge and understanding of intelligent manufacturing, and to work together to build a good ecosystem for e-commerce enterprises and promote the sustainable and healthy development of the social economy.

Keywords: Intelligent manufacturing; e-business; operations management; enterprise; applications and insights

1 Introduction

Enterprise management production and operation management development has a long history, is the third largest content in enterprise management in addition to financial management and marketing management, intelligent manufacturing is accompanied by the development of science and technology should come into being production mode [1]. The article starts from the meaning and development stage of production and operation management and intelligent manufacturing, analyzes the application of intelligent manufacturing in e-commerce and the impact on enterprise operation management, and provides reference for production and operation management [2].

1.1 Development stage of enterprise operation management

(1) Pre-industrial society period: Production operations management is mainly reflected in the extractive industry and agriculture, production activities are mainly based on manual labor, and the organization of the family is the basic unit of production. At this time, there is almost no production and operation management [3].

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(2) The period of industrialized society: Began to develop the manufacturing industry, and gradually began to utilize machines and power production, production in factories as a unit. At this time, production operations management is mainly manufacturing production management [4].

(3) Post-industrialization period: The service industry becomes the industry with the largest proportion, and the production mainly relies on information, knowledge and the use of intelligent production tools, and the production organization is in various forms, which can be an enterprise or a project group. At this time, production and operation management began to involve the service industry and became the real meaning of production and operation management [5].

1.2 Meaning of enterprise operation management

(1) Some scholars refer to production operation management as production operation management, which is considered to be the management of the whole process from input to output of production operation. This definition categorizes production operations management as manufacturing production and considers production operations management as mainly manufacturing production operations.

(2) Another part of scholars believe that production operation management should include manufacturing and service industries, and is the management of product manufacturing and service processes. Under the rapid development of the modern economy and society, the development of the service industry and its operation management should be emphasized. The research involves the management of production and operation management including the management of manufacturing and service industries.

1.3 Problems arising from production operation management

1.3.1 Enterprises [6]: In traditional production operation management, manufacturing and service-oriented enterprises in general have problems such as slow development, insensitivity to the market, inaccurate forecasts unclear goals, etc. Most of them set up production and operation plans from within the enterprise, and when the forecasts are inaccurate or changes are encountered, there may be a large number of backlogs of products.

1.3.2 Management [7]: The biggest problem in traditional production and operation management is the balance between production supply and demand, especially inventory management.

1.3.3 Personnel [8]: Traditional production and operation management does not have high requirements for talent, and a large number of production and operation management personnel do not have professionalism, production and operation management is relatively chaotic, and it is difficult to carry out management work in a systematic way.

1.3.4 Technology [9]: In traditional production operation management, the use of information technology is low, and more experience and subjective judgment are used. The communication and management informationization of the enterprise is low, and there are some paper-based office and paper-based management phenomena.

2 Concept and current progress

2.1 The concept of intelligent manufacturing and e-commerce

Smart manufacturing is not a new technology, but a comprehensive technology combined by a variety of data technologies. The application of smart manufacturing can help enterprises and governments better understand market trends and public opinions, optimize products and services, and improve work efficiency and quality. Intelligent manufacturing is an important development direction for enterprise development and has a wide range of application prospects in the economy, society, and other fields, with broad development space and potential.

E-commerce, short for electronic commerce, refers to the buying and selling of goods and services over the Internet. It involves conducting commercial transactions through websites, mobile apps, or other smart devices. E-commerce enables businesses to reach a global audience, streamline operations, and provide customers with convenient online shopping experiences. E-commerce can be conducted, including business-to-business, business-to-consumer, consumer-to-consumer, and consumer-to-business. The mathematical model of e-commerce website competition is shown in equation (1)

$$\begin{cases} \frac{dx_1}{dt} = \alpha_{x2}(\beta_i - x_1) - \gamma_{12}(1 + \omega(x_2 - x_1)) \\ \frac{dx_2}{dt} = \alpha_{x1}(\beta_j - x_2) - \gamma_{21}(1 + \omega(x_1 - x_2)) \end{cases} \tag{1}$$

x_i denotes the users who need e-commerce transactions for the ith website. β represents maximum capacity, α_i represents the fixed growth factor and γ represents the transfer coefficient. More specifically, the general model for competition in e-commerce transactions is shown as equation (2).

$$\frac{dx_i}{dt} = \alpha_{xj}(\beta_i - x_i) - \sum_{j=1,j\neq i}^{n} \gamma_{ij}(1 + \omega(x_j - x_i)) \tag{2}$$

2.2 Meaning and stage of intelligent manufacturing

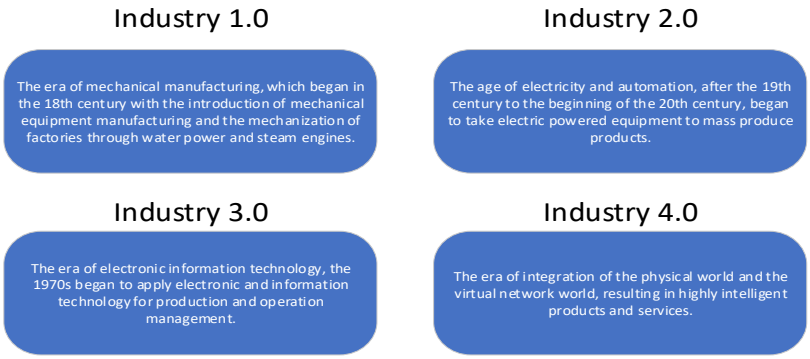

Fig. 1. Progress of the industrial revolution.

Intelligent manufacturing is a new production technology and production mode proposed in the stage of Industry 4.0. Intelligent manufacturing originates from artificial intelligence, which

contains intelligent manufacturing technology and intelligent manufacturing systems with the ability to autonomously upgrade, collect, analyze, and judge. The milestones of the industrial revolution can be described in Figure 1.

3 Impact of smart manufacturing on operation management

Intelligent manufacturing is the main production technology in the period of Industry 4.0, before the emergence of intelligent manufacturing, other periods of production technology had a certain impact on the production and operation management at different stages. Industry 1.0 stage had an impact on the management of production operations in the late pre-industrial society, the idea of mechanical manufacturing gradually converted manual labor into semi-automatic mechanical production. At the beginning of industrial society, the application of steam and water conservancy accelerated production efficiency and gradually produced production management. Industry 2.0 stage mainly affected the industrial society period, the invention of electricity was widely used in production, the mainstream factories began to use electricity for mass production and gradually formed automation, so that the realization of the early post-industrial society, production and operation management possible. Industry 3.0 stage, the rapid development of electronic information technology, so that semi-intelligent assembly lines widely used in various factories, began to form a fully automated mode, production, and operation management is gradually moving towards a paperless, high-efficiency management mode. At the stage of Industry 4.0, the impact of intelligent manufacturing on production and operation management is mainly divided into the service industry and manufacturing industry in terms of enterprise management, product content, human resources, and technical information. Besides, the pattern of the consumers changed as in Figure 2.

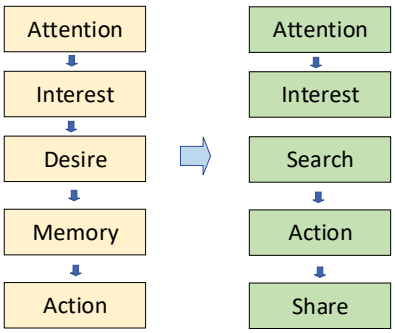

Fig. 2. Shifting patterns of consumer behavior in e-commerce.

3.1 Enterprise management

In the manufacturing industry, intelligent manufacturing on the manufacturing industry's enterprise management is mainly reflected in the production supply and demand balance, starting from the market demand, pulling the subsequent production and its management, realizing the production for the market demand service, the first demand and then production, reducing the waste of inventory and production capacity, and better implementation of lean production in the production and operation management.

3.2 Product content

In terms of service content, with the help of artificial intelligence technology, develop service products that are more reasonable and satisfy customers' needs. With the support of technology, individualized customer needs, and personalized customization are realized. Artificial intelligence makes the service process more convenient and comfortable, and the customer's service experience of the product is better.

In terms of manufacturing products, products relying on intelligent manufacturing are more capable of meeting customer needs, making mass customization possible, with more scientific and excellent product performance, making the customer experience better, and achieving the goals of energy saving and cleanliness, which have a certain effect on the utilization of resources and environmental protection.

3.3 Human resources

Human resources in the service industry have always occupied the main cost of enterprise production, artificial intelligence can share part of the human resources work, saving labor costs, making human resources management more timely and accurate, and salary performance management more convenient and effective. In terms of human resources in the manufacturing industry, the improvement of production lines and assembly lines through intelligent manufacturing can realize the unmanned operation production of most production lines and only need to keep the core position personnel for management, which can save human resources costs and reduce the burden of human resources management, so that the management of human resources focuses on the selection of middle and senior talents and the cultivation and retention of talents.

3.4 Technical information

The use of a better technical information platform can improve efficiency, reduce service costs, make service technology more scientific and reasonable, keep up with market demand, research and development of more excellent service products, and provide better service for customers. The overview of smart manufacturing is given in Fig. 3.

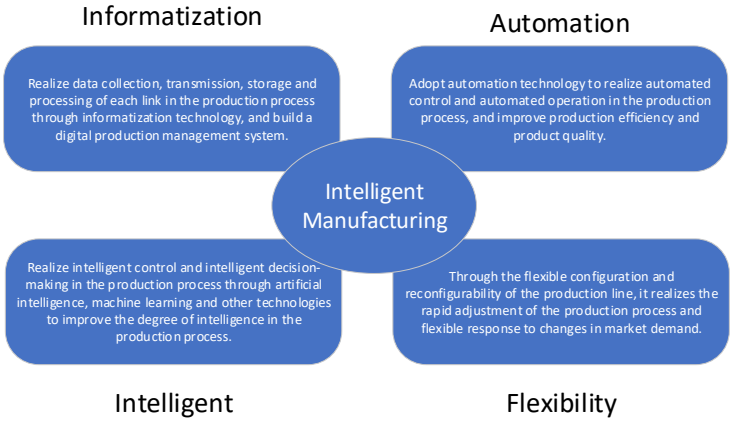

Fig. 3. A brief description of the characteristics of smart manufacturing.

4. Practice of smart manufacturing technology application in the field of e-commerce

4.1 Characteristics of the application of smart manufacturing in the field of e-commerce

Smart manufacturing is a set of manufacturing practices that use networked data and information and communication technologies (ICTs) for governing manufacturing operations. In the field of e-commerce, smart manufacturing can help businesses streamline their operations and provide customers with convenient online shopping experiences. By using smart manufacturing, businesses can reduce costs, improve efficiency, and increase productivity. Smart manufacturing can also help businesses reach a global audience and provide customized products to exploit new and existing markets.

4.2 Application of intelligent manufacturing in personalized recommendation of e-commerce platforms

As an essential part of the e-commerce industry, personalized recommendation is crucial for improving user shopping experience and promoting sales growth. The application of intelligent manufacturing technology can provide e-commerce enterprises with better-personalized services and product recommendations. Specifically, the use of intelligent manufacturing to achieve e-commerce platform personalized recommendation has the following three advantages: (1) personalized recommendation can help enterprises to understand the real needs of users, to accurately match their needs and preferences; (2) personalized recommendation can improve user satisfaction so that they can get a better shopping experience, increase customer loyalty; (3) personalized recommendation can also increase sales and optimize the supply chain management, to bring more revenue for the e-commerce enterprise. For e-commerce enterprises to bring greater benefits.

4.3 Logistics-based e-commerce supply chain optimization

Logistics is one of the most important links in the field of e-commerce and plays a vital role in the entire e-commerce supply chain system. The application of intelligent manufacturing technology in logistics can optimize efficiency and reduce the cost of the e-commerce supply chain. The optimization of the e-commerce supply chain using intelligent manufacturing technology has the following two advantages: (1) Through the use of intelligent manufacturing technology, e-commerce enterprises can better monitor the logistics process, identify problems and solve them promptly, thus improving the efficiency and accuracy of logistics; (2) Optimization of the e-commerce supply chain can also enhance the enterprise's understanding of the market demand, to provide enterprises with more accurate logistics solutions, to help enterprises to obtain a higher level of customer satisfaction and market competitiveness. Specifically, e-commerce enterprises can analyze multiple factors such as transport routes, transport time, transport modes, etc. to optimize logistics management and achieve faster, more reliable, and more efficient transport services. The market data of the smart manufacturing is given in Table 1.

Table 1. Global Smart Manufacturing Market Size [10].

Year	Amount ($ billion)	Growth rate (%)
2019	2159	4.54
2020	2257	8.21
2021	2459	8.21
2028 (Estimated)	5762	4.29

5. Smart manufacturing application practices

5.1 Characteristics of applications in smart manufacturing

The applications of smart manufacturing are vast and varied. In the field of e-commerce, smart manufacturing can help businesses streamline their operations and provide customers with convenient online shopping experiences. By using smart manufacturing, businesses can reduce costs, improve efficiency, and increase productivity. Smart manufacturing can also help businesses reach a global audience and provide customized products to exploit new and existing markets. In the automotive industry, smart manufacturing can help businesses optimize their supply chain, reduce waste, and improve quality control. In the aerospace industry, smart manufacturing can help businesses reduce production time, improve quality, and reduce costs. In the pharmaceutical industry, smart manufacturing can help businesses improve their production processes, reduce costs, and increase efficiency.

5.2 Intelligent manufacturing production scheduling optimization research

Multi-dimensional data collection and analysis: Adopt sensors and other technical means to collect and monitor the logistics, equipment, and workers in the production process in real-time, and effectively analyze and screen them through data prediction, abnormality detection, and other technical means to provide accurate decision support. Production planning and scheduling: Based on the collected production data, establish an accurate model for production planning and scheduling. Through continuous optimization algorithms and dynamic adjustments, we aim to maximize output and minimize costs to improve production efficiency and quality. Intelligent equipment management: Based on big data technology, it realizes remote monitoring, maintenance, and overhauling of equipment, and optimizes the use and maintenance of equipment through data analysis, to reduce the frequency of failures and downtime, and ensure the stability and continuity of the production process.

5.3 Intelligent manufacturing process quality monitoring system construction

Data acquisition and pre-processing: Through the use of sensors and other technical means, real-time monitoring of logistics, equipment, workers, etc. in the production process, and through data cleaning, feature extraction, and other technical means, preliminary processing and pre-processing of the collected data to meet the subsequent statistical analysis and modeling needs. Data mining and modeling: through data mining technology, for different parts of the production

process, the use of machine learning, neural networks, and other methods, to establish the corresponding data model, identify possible quality problems, and provide strong support for the traceability of quality problems. Authority and responsibility process sorting and formulation: Based on the establishment of an intelligent manufacturing process quality control system based on big data, it is necessary to clarify the relationship between authority and responsibility of each link and the workflow, and to formulate a perfect operation specification and quality management system, to effectively carry out quality control. Real-time monitoring and early warning: Combine real-time data acquisition and processing technology to build a real-time monitoring and early warning mechanism, timely early warning when quality problems or potential risks are found, rapid response, and information technology means to achieve rapid disposal.

6 Conclusion

The service and manufacturing industries carry out smart manufacturing relying on artificial intelligence, which has a positive impact on their enterprise management, product content, human resources, and technical information, as well as higher requirements for service and manufacturing enterprises. The rapid development of technology in the context of smart manufacturing requires more adaptability and resilience from enterprises. Enterprises need to devote more time to the future development planning of the enterprise as well as internal core management. The level of scientific and cultural knowledge of human resources is required to be higher, simple and repetitive work is more often undertaken by machines, and the employees of enterprises are more likely to undertake technical and analytical work, and the ability of employees to analyze data and make judgments and decisions is required to be higher. In terms of technology, science, and technology are changing rapidly, enterprises need to have a certain ability to recognize technology and forward-looking judgment and should explore the real meaning of technology applied to production and operation management, strengthen the enterprise's innovation and research and development ability in production and operation management, and improve the core competitiveness of the enterprise.

References

[1] Wang, Shi, et al. "Smart manufacturing business management system for network industry spin-off enterprises." Enterprise Information Systems 16.2 (2022): 285-306.

[2] Song, Zhiting, et al. "Smart e-commerce systems: current status and research challenges." Electronic Markets 29 (2019): 221-238.

[3] Menezes, Sherwin, Savio Creado, and Ray Y. Zhong. "Smart manufacturing execution systems for small and medium-sized enterprises." Procedia CIRP 72 (2018): 1009-1014.

[4] Chen, Mu-Yen, Edwin David Lughofer, and Erol Egrioglu. "Deep learning and intelligent system towards smart manufacturing." Enterprise Information Systems 16.2 (2022): 189-192.

[5] Serrano-Ruiz, Julio C., Josefa Mula, and Raúl Poler. "Smart manufacturing scheduling: A literature review." Journal of Manufacturing Systems 61 (2021): 265-287.

[6] Wang, Yujie, Xu Kang, and Zonghai Chen. "A survey of digital twin techniques in smart manufacturing and management of energy applications." Green Energy and Intelligent Transportation 1.2 (2022): 100014.

[7] Parhi, Shreyanshu, Kanchan Joshi, and Milind Akarte. "Smart manufacturing: A framework for managing performance." International Journal of Computer Integrated Manufacturing 34.3 (2021): 227-256.
[8] Feng, Shaw C., et al. "Toward knowledge management for smart manufacturing." Journal of computing and information science in engineering 17.3 (2017): 031016.
[9] Li, Bo-hu, et al. "Applications of artificial intelligence in intelligent manufacturing: a review." Frontiers of Information Technology & Electronic Engineering 18 (2017): 86-96.
[10] https://www.fortunebusinessinsights.com/