The New Connotation and Technology System of Enterprise Digital Transformation in the Era of Big Data

Liang Tang, Haojie Ling, Er'xu Shang*, Hong Tan, Huailong Liu

Liang Tang email: tangliang041128@163.com, Haojie Ling email: hylewis@126.com,
Er'xu Shang* email: shangerxu@163.com ,Hong Tan email: 18702874230@163.com ,
Huailong Liu email:longliuhuai@126.com ,

(Sichuan CLP Qixing Information Technology Co., Ltd., Chengdu, Sichuan, 610220, China)

Abstract: The integration of new generation information technology and manufacturing industry has promoted the rapid development of industrial digital economy, data has grown into an important strategic asset for manufacturing enterprises, and the value mining and utilization of data has become an important driving force for the current digital transformation and upgrading of enterprises. With data management as the core, it is proposed to divide the digital transformation of manufacturing enterprises into four development stages, such as manual-based rough management, information technology-based digital management, industrial Internet-based big data management, and intelligent management based on a new generation of artificial intelligence. The new connotation of digital transformation of manufacturing enterprises in the current era of big data is elaborated from various dimensions such as driving elements, conceptual changes and basic features, on the basis of which the system architecture and key technology system of digital transformation are discussed from the perspective of the whole life cycle of data, and finally the development direction of the current manufacturing enterprises to promote digital transformation is pointed out.

Keywords: big data era; enterprise digitalization; transformation; connotation; technology system

1.Introduction

In order to build the competitive advantage of their manufacturing industries, countries all over the world have been vigorously developing smart manufacturing in the past 10 years, aiming at the development of digital transformation through the Internet of Things,

For example, the United States has proposed the "Advanced Manufacturing Partnership", Germany has proposed the "Industry 4.0 Strategic Plan For example, the United States has proposed the "Advanced Manufacturing Partnership", Germany has proposed the "Industry 4.0 Strategic Plan", China has proposed "Made in China 2025", and Japan has proposed the "Social 5.0 Strategy". At the same time, in the national "14th Five-Year Plan and 2035 Vision Outline" released in March 2021.

It is also clearly pointed out that we should promote the digital transformation of industries, give full play to the advantages of massive data and rich application scenarios[1], promote the

ICPDI 2023, September 01-03, Chongqing, People's Republic of China

DOI 10.4108/eai.1-9-2023.2338721

deep integration of digital technology and the real economy, empower the transformation and upgrading of traditional industries, and give birth to new industries and new business models. At the enterprise level, the General Electric Company of the United States formally proposed the concept of industrial Internet in 2012, aiming to create an industrial Internet operating system, i.e., an industrial Internet platform, and then provide services for manufacturing enterprises in the form of industrial APPs and microservice components. In recent years, under the vigorous promotion of the government, academia and industry, the development of China's industrial Internet has also entered the fast lane, and many cross-industry and cross-discipline industrial Internet platforms have emerged, such as Haier, UFJ, Sany Shugen Internet, Aerospace Cloud Network, etc., forming a new model of personalized customization, networked collaboration, intelligent production and service extension based on the industrial Internet. Among them, industrial big data is the core and support of industrial Internet platform operation[2].

To this end, this paper puts forward the development stage of digital transformation of manufacturing enterprises with data management as the core, and elaborates on the new connotation, system architecture and key technologies of digital transformation of manufacturing enterprises in the current big data era, so as to provide theoretical guidance for promoting digital transformation of manufacturing enterprises.

2. Development stage of digital transformation of manufacturing enterprises

In the development of manufacturing industry, data has always played a very important role. At the early stage of the development of the machinery industry, when it was still in the single-piece production mode, workers were highly skilled in design, machining and assembly, and most of them were skilled craftsmen who knew the principles of design and were familiar with the properties of the materials used. In this model of workshop teamwork, communication was mainly through language (i.e., data transfer), and the data was still mainly stored in the workers' brains. With further industrial discoveries, especially after World War I, the advent of mass production maximized the application of the idea of division of labor and prompted the creation of a new breed of professionals. This professional division of labor was carried out not only on the shop floor but also in the engineering departments, such as dividing workers into machine operators, quality control workers, etc.; and engineers into structural design engineers, process engineers, etc. Along with the development of professional division of labor, various easy-to-understand, accurate and efficient methods of expressing information such as product design and manufacturing were gradually adopted to support the definition and transmission of data at various stages of the whole product life cycle[3], such as product design, process design, processing, assembly and maintenance. This is when the accuracy and standardization of data representation becomes very important because of the need for cross-disciplinary and cross-disciplinary communication in product development.

Since the middle of the 20th century, with the rapid development of microelectronics, automation, computers, communications, networks, information, artificial intelligence and other high technologies, a wave of new technological revolution with the information revolution as the core has been set off. Starting from the 1950s CNC processing, has

experienced the first generation of digital manufacturing technology represented by CAD / CAPP / CAM and other computer-aided technology, the second generation of digital manufacturing technology represented by computer integrated manufacturing (CIMS), and the third generation of digital manufacturing technology represented by networked manufacturing technology, and now is entering the intelligent manufacturing technology represented by The fourth generation of digital manufacturing technology. The scope of data management has also developed from the initial product model data management to the manufacturing data of the workshop site and even the whole product life cycle data management. At the same time, with the rapid spread and application of the Internet of Things, industrial Internet, cloud computing and other new generation information and communication technologies, manufacturing data sources and data volume has increased dramatically, and the era of big data has arrived. At present, data has grown into an important strategic asset for manufacturing enterprises, and the value mining and utilization of data has become an important driving force for digital transformation and upgrading[4].

Starting from the above data management history, data management has mainly gone through four stages, such as data paper-based, data electronic, data sea quantization and data intellectualization. Based on this, the digital transformation of enterprises can be divided into four development stages, which are: manual-based rough management, information technology-based digital management, industrial Internet-based big data management, and intelligent management based on a new generation of artificial intelligence.

3. New connotation of digital transformation of manufacturing enterprises in the era of big data

In the current era of big data of business interconnection, with the continuous promotion and in-depth implementation of Industry 4.0 and smart manufacturing strategy, many manufacturing enterprises start to use big data analysis and other means to optimize the manufacturing process in the process of promoting digital transformation, so as to improve manufacturing efficiency and product performance.

In order to improve manufacturing efficiency and product performance. In this regard, the new connotation of digital transformation of manufacturing enterprises in the era of big data is analyzed from the aspects of driving elements, concept change and basic features[5].

3.1 Two new driving factors

In order to realize the digital transformation and upgrading of manufacturing enterprises, it is necessary to realize the transformation from experience-driven to data-driven and from independent-driven to interconnection-driven at the level of driving elements. On the one hand, by tapping the hidden insight and foresight value behind big data, manufacturing enterprises can provide new means for accurate business decision making, operation mode innovation, etc., and also help enterprises understand customer needs and future development trend precisely, comprehensively and timely, so as to provide more personalized and customized services[6]. On the other hand, through the interconnection and information flow interaction between the whole elements of worker-machine-thing-loop, it will help manufacturing enterprises achieve flatter organization and management, making the organization, production

and operation more flexible, thus significantly improving the efficiency of product development and production and the utilization of production factors, and The big data foundation is laid for data intelligence and data drive.

3.2 Three new concept changes

Compared with the digital management in the information era, the digital transformation in the big data era has new transformations in management objectives, management strategies and decision-making methods, as shown in Table 1.

Table 1 Comparison of digital management in the information age and digital transformation in the big data age

	Digital Management in the Information Age	Digital transformation in the era of big data
Data Business Relationships	Data Assist Business	Data-driven business, data innovation business
Data Value Utilization	Hindsight values	The value of insight and foresight
Management Objectives	Business execution efficiency improvement	Business value enhancement, business model innovation
Management Strategy	Reactive management after the fact	Real-time management in the event, predictive and proactive management in advance
Decision-making approach	Based on experience and data statistics	Based on big data intelligence and knowledge
Enabling Technologies	Traditional Information Technology	Internet of things, big data, cloud computing and other New generation information technology

In the stage of rough management and digital management, enterprise management and business decisions are mainly based on experience and data statistics; but in the stage of big data management, it will change to accurate decisions based on big data intelligence and empirical knowledge. The mining of data value is not only simple, post-facto data statistics, but complex, in-fact insight and pre-emptive insight based on multi-source massive big data intelligence[7]. At the same time, with the standardization and standardization of business process, continuous mining of data value and continuous accumulation of knowledge, knowledge will also play an important supporting role in the decision-making process of business.

4. System architecture of digital transformation of manufacturing enterprises in the era of big data

Complete, accurate, real-time, high-quality and structured data is the basis for digital transformation of manufacturing enterprises. In order to effectively cope with the demand for massive multi-source heterogeneous data management and value mining in the context of big data era, manufacturing enterprises need to manage their massive data assets by means of data governance. Data assets are data resources, such as documents and electronic data, that are owned or controlled by an enterprise and can bring future economic benefits to the enterprise in physical or electronic form.

Data governance is to manage the data of an organization (enterprise or government department) as a strategic asset by establishing a set of management mechanisms from data collection to processing and application, with a view to improving data quality, achieving extensive data sharing, and ultimately maximizing data value. Data collection, transmission, storage, management, cleaning, fusion

The whole process of data collection, transmission, storage, management, cleaning, fusion, analysis, mining, visualization and application is called the whole life cycle of data. As the data of manufacturing enterprises can be mined in many aspects of the data lifecycle, the digital transformation architecture of manufacturing enterprises in the era of big data based on the data lifecycle is constructed.

Reliable transmission of data is a prerequisite for realizing data application and value mining of manufacturing enterprises. For different business scenarios and data security requirements, different data transmission methods are required, mainly including industrial Ethernet, fieldbus, LAN, Internet, sensor network, wireless network, mobile network, etc. For example, for some business scenarios with strong timeliness and high reliability requirements, such as adaptive control of machine tools, industrial robots, robotic arms and other equipment and actuators, complete, accurate and real-time data transmission is required, so industrial Ethernet and field buses are mostly used. For some business scenarios with extremely high confidentiality requirements.

5. Conclusion

With the mining of data value, the continuous discovery and accumulation of knowledge, coupled with the continuous progress of technology and the continuous development of society

In the era of human-oriented wisdom of Industry 5.0, knowledge will become an important tool for sustainable development and competitiveness of enterprises in addition to data. At that time, the management of manufacturing enterprises will move from data-driven to knowledge-driven. Through the interconnection, collaboration and integration of knowledge among human-machine and object intelligences, it will not only essentially improve the ability of manufacturing enterprises and industrial systems to deal with complexity and uncertainty, but also give rise to new business modes, new models, new industries and new applications based on knowledge, such as industrial knowledge push, industrial knowledge service and

industrial knowledge collaboration, thus promoting the development of knowledge economy.

References

[1] Liu QIANHUA, Li KUNPING, Zhuang CUNBO, et al. New connotation and technical system of digital transformation of manufacturing enterprises in the era of big data [J]. Computer Integrated Manufacturing Systems,2022,28(12):13.

[2] Shi Jinling. Analysis of the motivation, path and effect of digital transformation of enterprises: A case study of Sai Lun Group[D]. Guangzhou University, 2022.

[3] He Da'an. Stages and conditions of digital transformation of enterprises: a theoretical analysis based on "big data composition"[J]. Academic Monthly,2022,54(4):12.

[4] Ma, Mengjiao, Zhang, Binghui. Research on the impact of digital transformation of enterprises on employee recruitment in the era of big data[J]. Hehe Journal,2022(3):8.

[5] Jiu Jiayou. Big data helps the road of digital transformation of internal audit of enterprises with high quality development [J]. Economic Management Research,2021,3(3):65-67.DOI:10.12346/emr.v3i3.3403.

[6] Gudda P .Moderating Effect of Entrepreneurial Orientation on the Relationship between Clustering and Product Innovativeness of Manufacturing Micro and Small Enterprises in Kisumu City, Kenya[J]. 2015.

[7]Wiendahl H P , Engelbrecht A , Hamacher O .From Single Enterprises to Complementary Networks[C]//International Working Conference on the Design of Information Infrastructure Systems for Manufacturing.Springer, Boston, MA, 2000.DOI:10.1007/978-0-387-35412-5_8.