Annual Meeting of the New Champions 2018

2018新领军者年会

The 4th industrial revolution and the innovative society

第四次工业革命与创新型社会

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智能制造与传统产业变革

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Intelligent Manufacturing and the Transformation of Traditional Industries

Liu Jing
Hebei University of Technology

Abstract: Driven by Technological revolution and "Made in China 2025", Chinese manufacturing enterprises have been very much engaged in the process of intelligent transformation. In order to transform and upgrade traditional industries into intelligent manufacturing, new generation of information technology has to be integrated into the manufacturing industry, which is taking place. A new generation of technologies represented by the Internet, big data, cloud computing, artificial intelligence, etc., is expanding from the consumption link to the manufacturing one, from the improvement of transaction efficiency to that of production efficiency, and ultimately optimizing all manufacturing resources incrementally.

The multi-source and heterogeneous industrial Internet of Things facilitates the development of intelligent manufacturing; edge computing performs smartly by object-end embedded computing; industrial cloud ecologically integrates sharing and innovation capabilities. The combination of these three technologies enables the collection, storage, flow, and analysis of industrial data.

At present, China's manufacturing industry has a very strong demand for intelligent upgrading, but the overall foundation is very weak. It is proposed that at this stage, we should speed up the development of intelligent infrastructure stage by stage, explore the value of production data in industries, and build an industrial full-chain ecosystem in an innovative manner.

Catalog

1 The Trend of in-depth integration of new generation information technology and manufacturing industry

Science and technology are the primary productive forces, and technological innovation is the fundamental driving force for economic and social development. As shown in Figure 1, the First Industrial Revolution featuring the invention of steam engines freed human beings from some physical labor and separated handicrafts men from agriculture. The Second Industrial Revolution featuring the invention of electricity freed human beings from more physical labor and greatly improved productivity. Human society has entered the modern industrial period. The 4th Industrial Revolution was marked by the innovation and application of information technology such as calculation or computing, communications, and control. This round of industrial revolution liberated humans from not only physical labor, but also from mental labor to a certain extent. Industrial development was pushed to a new height. Since the new century, a new generation of information technology has seen explosive growth. The application of technologies such as Internet of Things (IOT), big data, and artificial intelligence in manufacturing has formed a major driving force for a new round of industrial revolution. Therefore, the 4th Industrial Revolution should be based on a new generation of information technology, thereby triggering major and profound changes in the development of manufacturing

concepts and modes to push global manufacturing into a new stage.

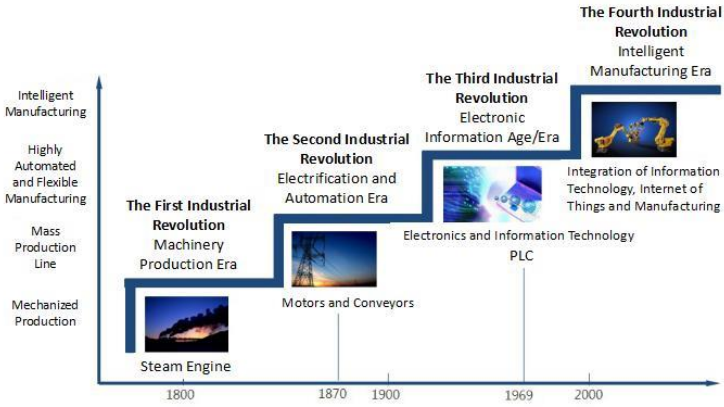

Figure1 Process of Industrial Revolution

At present, a new round of scientific and technological revolution has met historical industrial change. Chinese President XI Jinping stressed that the world economy accelerated sectors involving information technologies. It is necessary to seize this historical opportunity and develop information industry into a driving force for growth. As an important part of industrial transformation, intelligent manufacturing is becoming the key of global manufacturing transformation and technological innovation.

1.1 The new generation of information technology is spreading from the consumption link to the manufacturing link

The new generation of technologies represented by the Internet, big data, cloud computing, artificial intelligence, etc. has structured

the layout of consumption links. By accelerating the spread of manufacturing links, it helps companies achieve intelligent production, networked collaboration, personalized customization and services transformation.

The first phase of the application of the new generation of information technology is focused on the consumption link, including marketing, procurement, logistics, after-sales and other commercial processes. It digitizes the behavior and status of users and business processes. Based on multi-dimensional data analysis and scene perception, the information map of the consumer industry is drawn up for industry users to enjoy personalized services. The main features of this process are as follows:

1. Ubiquitous network connections enable fast flow of data;
2. Cloud computing provides low-cost infrastructure services to cope with business load changes;
3. Big data mining, analysis and management of massive data enhance the business decision-making ability of enterprises;
4. Algorithm + data + computing power unleash the potential value of industry intelligence.

The second stage of the new generation information technology application is focused on the manufacturing, which mainly includes: product planning, design, manufacturing, operation, and other production processes, i.e., production equipment and process flow, etc. These links have been gradually digitized and networked. The

products and equipment are taken in broad terms, including products manufactured by manufacturing industries and lines, as well as necessary assets for energy, transportation, agriculture, and public utilities and other service industries. The assets include electricity meters and transportation vehicles, agricultural machinery, environmental monitoring instruments, etc. The main features of this process are as follows:

1. Improve the agility and collaboration of production and service processes;
2. Improve resource sharing and reduce energy consumption;
3. Reduce production operations and operational uncertainty;
4. Establish "end-to-end" industry intelligence for production, sales, and services.

The wide application of a new generation of information technology has spread from the consumption link to the manufacturing link, and has continuously transformed production methods, so that manufacturing can be flexible, networked, green and intelligent. At the same time, it also brings the industrial internet, and a large number of new production concepts such as Industry 4.0. The production process will consist of new sensors, intelligent control systems, robots, and automated complete sets of production lines. The number of "unmanned factories" will continue to increase; industrial information systems will be interconnected and integrated through the Internet, and machine operations, workshop distribution,

enterprise production. Real-time interaction among demands, raw material supply, parts production, product integration assembly and other whole production processes become more accurate and coordinated. Intelligent analysis tools such as industrial cloud platform and industrial big data will help enterprises to make better decisions.

1.2 The new generation of information technology extends from improving transaction efficiency to improving production efficiency

E-commerce and Internet platforms bring lower transaction cost and higher efficiency. The new generation of information technology aims to improve the efficiency of customized services by transforming manufacturing resources with cloud, sharing manufacturing capacity and innovate through human-machine intelligent integration.

The development of intelligent manufacturing is accompanied by the advancement of information technology. The development of global informatization can be divided into three stages. From the middle of the last century to the mid-1990s, informatization was marked by digitization featuring computing, communications, and control applications. From mid-1990s onward, the Internet has been widely used and popularized, and informatization has entered the stage featuring the Internet of Everything. Currently, progress in big data, cloud computing, mobile Internet, industrial Internet clusters,

and convergence applications brought strategic breakthroughs in artificial intelligence. Informatization has entered the intelligent stage featuring the new generation of artificial intelligence technology. Applied in traditional industries, these technologies turn the focus from transaction efficiency to production efficiency:

1. Intelligent manufacturing facilitates the deep integration of information technology, intelligent technology, network technology and manufacturing technology;
2. Intelligent manufacturing covers the life cycle of all products, though the fields of design, production, management and service;
3. The goal of intelligent manufacturing is to achieve high efficiency, high quality, flexibility, cleanliness, safety, and agility to improve the rapid response and competitiveness of the company to the market;
4. Intelligent manufacturing is a system that replaces the human labor force by analyzing, deciding and reacting to big data in the production process.

The new generation of information technology will run through manufacturing activities such as the design, production, management, and service of the enterprise, which can effectively shorten the product development cycle, reduce operating costs, increase production efficiency, improve product quality, and reduce resource consumption.

1.3 The new generation of information technology is upgrading from

local optimization of manufacturing resources to global optimization

In the traditional manufacturing industry, a complex problem is usually solved piece by piece. The advantage of this method lied in its efficiency, but at the same time, it will bring information (isolation) island issues. In order to solve this problem, intelligent manufacturing aims at serving users' needs. Based on the integration of manufacturing technology and new information technology supported by large data stream of industrial Internet, intelligent analysis, judgment and decision are carried out throughout the whole life cycle of the product. This requires collaboration between the physical world and the digital world's industrial chain. It requires data integration throughout the product life cycle and various industrial players in the value chain to establish a collaborative ecosystem. This multi-chain collaboration and integration puts higher requirements on end-to-end data flow and full life cycle management.

Through the transformation of factories from machines and production lines to workshops, intelligent hardware and software technology, control systems and information systems can be applied to the entire production process. The use of intelligent systems to analyze and update information enables high-efficiency control, automatic decision making, accurate implementation, and production sensing and data collection with a large number of smart manufacturing component, resulting in effective, flexible, clean, safe, and rapid production Therefore, production management is timely,

scientific, and realizes process automation, intelligent processing, digital machinery, networked workshops, and unattended operations, enabling companies to use resources globally and virtualize and network supply chains. At the same time, intelligent manufacturing has transformed the organization and form of industry from manufacturing to service-oriented manufacturing and transformed manufacturing companies from product suppliers to product and service providers.

In summary, the next-generation information technology with Internet of Things, cloud computing, big data, and artificial intelligence at the core can realize cross-level and cross-domain integration and will promote optimization of manufacturing resources spread from some links to the whole chain.

2 The core of intelligent manufacturing technology

As technological changes take place around the world, intelligent manufacturing has become the core of a new round industrial revolution, which is the key point and chief direction of innovation, transformation and upgrading in manufacturing industries. Chinese manufacturing enterprises must invest in intelligent transformation. The core of realizing intelligent manufacturing and upgrading traditional industries is the deep integration of new generation information technology and manufacturing industry.

The core of the development of intelligent manufacturing

technology includes the industrial Internet of Things, edge computing and industrial cloud ecology. The industrial Internet of Things is the basis for the realization of intelligent manufacturing; the edge calculation has an irreplaceable role in the industrial fields such as real-time, short period data, local decision and so on; and the cloud computing is suitable for non-real-time, long period data, and business decision making scenario. Intelligence is based on the intelligent analysis of data, so as to realize the intelligent decision-making and intelligent operation of production and realize the continuous intelligent optimization of business process through the closed loop. The combination of the three has realized the collection, storage, flow and analysis of industrial data, which is the key to the success or failure of intelligent manufacturing in the transformation of traditional industries.

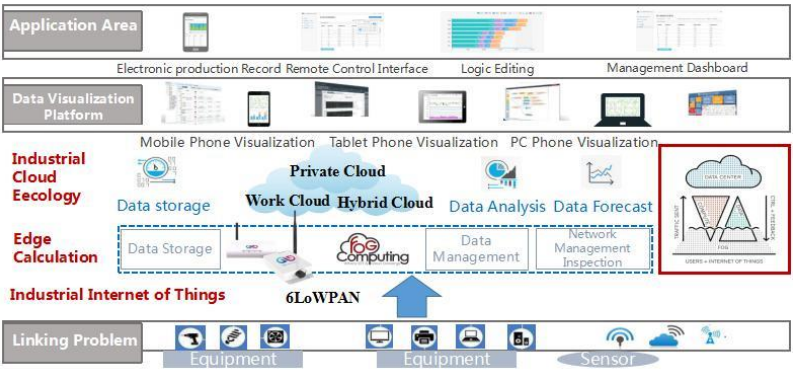

Figure2 Core of Intelligent Manufacturing

2.1 The multi-sourced and heterogeneous industrial IOT helps

intelligent manufacturing

The industrial Internet of things (IOT) is an integration of industrial systems and the Internet, as well as advanced computing, analysis, and sensing technology to achieve intercommunication between people, machines, raw materials, products, and business. A typical smart factory is made up of highly heterogeneous devices. At present, more than 6 Ethernet technologies are implemented in industry alone, more than 40 industrial buses are used, but a unified definition model for industrial information and services is absent. At the same time, this process includes not only the interconnection of infrastructure, but also the optimization of connection speed and high network security characteristics.

Data acquisition in manufacturing industry is relatively more complex. In order to integrate multi-sourced and heterogeneous data, two problems need to be tackled. On one hand, the quality of data should be ensured because it determines the quality of decision. The quality of data may be undermined by manual errors in data integration process, or errors of pattern matching in the process of automatic integration. The distributed data exchange will lead to the interruption of the task due to the instability of the network and the diversity of the data. It is necessary to provide real-time task monitoring to get the specific location of the data and identify the problem. On the other hand, it is difficult to integrate all the data generated in the life cycle of the product in real time. If the real time

state data of the production line equipment can be combined with the data of the current production data, the material supply of the next moment (minute, hour) can be more reasonably guided. The existing technology can achieve real-time data capture and integration of second-level delay in some scenes, such as small amount of data and data from a unified type of database. However, in the scenario of manufacturing big data, it is necessary to take account of different types of massive data and meet real-time requirements. The big data processing model can be divided into two modes: batch processing and direct processing, which are stored in the first storage and processing. The flow processing takes data as a stream, and the continuous data makes up the data stream. The flow processing mode requires that the new data processing results can be returned in real time when the new data comes. Generally, scenarios with high real-time requirements are more suitable for the application of stream processing modes, such as sensor networks, industrial process automation and real-time control.

As shown in Figure 3, the new generation of information technology (big data, cloud computing, artificial intelligence and industrial Internet of Things) can be assigned to traditional enterprises to solve the problem of obtaining effective data in the multi-sourced and heterogeneous industrial Internet of Things, which is the basis of intelligent manufacturing by obtaining data from equipment in the factory, PLC and other sensors. Real time

integration of data generated in all phases of production life cycle will truly help the implementation of intelligent manufacturing.

Figure3 Multiple Information Technologies Empowers Traditional Enterprises

2.2 Edge computing performs intelligently by using embedded computing power of object end.

The network is the cornerstone of system interconnection and data transmission. With the rapid development of the Internet of Things, the number of access nodes is growing exponentially. Each IOT node will generate a large amount of real-time data, accompanied by a dramatic increase in the number of connected devices, and network transmission. The real-time nature and network bandwidth have brought new challenges and requirements for data storage, analysis and processing. Compared with traditional ubiquitous IOT devices, industrial devices have imposed higher requirements on the real-time performance, reliability, and security of computing. For example, in the field of production control, the service control delay must be less

than 10 milliseconds or even lower. In the production of a large number of heterogeneous data, data aggregation and a unified format are required. A relatively harsh industrial field operating environment needs anti-electromagnetic, dust-proof, explosion-proof, anti-vibration, anti-current/voltage fluctuation. All these impose higher requirements for equipment power consumption, cost, and space. The traditional cloud computing adopts the centralized architecture, which transfers all the collected data back to the cloud for processing. The above problems are difficult to deal with, especially when the network is unstable and cannot access the cloud. Therefore, the adoption of cloud computing mode alone in industrial applications can no longer meet the requirement of efficient processing of the massive data generated at the edge of the network. For industrial applications, characterized by large amount of data on the edge, large number of local application systems, and strong real-time requirements, it is necessary to increase the ability to perform task calculation and data analysis at the edge of the network. The breakthrough in edge computing technology provides an ideal direction for the development of the Internet of Things.

As shown in Figure 4, the edge computing adopts a distributed computing architecture. Most of the data and simple operations are distributed near the near-end device of the data source. The required data is converted into a unified format and uploaded to the cloud, thus split the workload of the cloud platform. Edge computing makes full use of the embedded computing capabilities of the object side, realizes the

intelligence and autonomy of the object side in a distributed information processing manner, and integrates with the cloud platform, and realizes the overall system intelligence through the interaction of the cloud. Through the deployment of the edge computing layer, many control calculations can be implemented through the local device without passing through the cloud, and the processing will be completed at the local edge computing layer. In this way, feedback can be provided to the on-site control in real time, which greatly increases the speed and efficiency of the processing and reduces the load on the cloud. In addition, because it is closer to users, it can also help users to filter and process confidential data. After desensitization, it can be used to solve the issues of key data integrity, confidentiality, mass production, or personal privacy data protection.

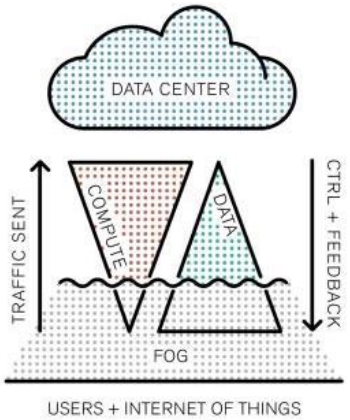

Figure4 Edge Calculation

In summary, edge computing provides real-time storage and

computing capability, with features of edge data collection, intelligent computing capability and operational decision feedback. Since the services on it are initiated on the edge side, a faster network service response is generated to meet the basic requirements of industrial applications in real-time business, intelligent computing, security protection, and privacy protection. At the same time, edge computing has distributed features, supports distributed computing and storage, enables dynamic scheduling and unified management of distributed resources, supports distributed intelligence, and has distributed security capabilities. Furthermore, edge-side intelligence can bring significant efficiency and cost advantages. Intelligent application scenarios represented by predictive maintenance are driving the industry to transition to new service models and business models.

2.3 Industrial Cloud Ecology Integrates Sharing and Innovative Capabilities

The report of the Nineteenth Congress put forward: “We will promote changes in the quality, efficiency and dynamism of economic development, and increase total factor productivity” and “promote the deep integration of the Internet, big data, artificial intelligence, and the real economy.” These are the directions for the integration of manufacturing and the Internet, leading the current integration of development into a new era, a new stage. Accelerating

the development of industrial cloud ecology is an important measure to implement the spirit of Nineteenth Congress and the focus of current work. In October 30, 2017, the Executive Council of the State Council passed the guidance of "deepening the Internet + advanced manufacturing industry" to develop the industrial Internet. At the meeting, Premier LI Keqiang pointed out that "some multinational companies have been pushing forward in the construction of industrial Internet platforms, which means ecology surrounding the large industrial cloud platforms and cloud platforms is becoming a vane that may lead the entire industrial revolution."

2.3.1 Use cloud services to reduce enterprises' information costs

Cloud services have typical characteristics such as resource pooling, elastic supply, and pay-as-you-go. They can significantly reduce the cost of purchasing R&D tools and improve R&D efficiency. Therefore, reducing costs is an important factor in the initial development stage of industrial cloud platforms. In April 2013, July 2014 and July 2015, the Ministry of Industry and Information Technology held industrial cloud on-site meetings in Beijing, Jinan and Nanjing for three consecutive years, and launched 16 industrial cloud innovation service pilots across the country to discuss how to reduce IT hardware costs, software costs, deployment costs and operating costs through cloud computing.

2.3.2 Use the cloud platform to realize information sharing

Migration to cloud is not just for the sake of cost. What is more important is to build a development system platform based on industrial clouds, to promote data exchange among suppliers all over the world, and to achieve collaborative design and collaborative manufacturing based on a single data source. That is, through the cloud on the core business system, we can open information (isolation) islands, promote the integration of manufacturing resources and data, and enhance corporate profits. This is also an important starting point for industrial companies to promote the migration of business systems to the cloud, and to achieve cross-enterprise collaborative R&D and manufacturing. There are three major problems of information asymmetry in current production: First, the allocation of manufacturing resources is not balanced. For example, the utilization rate of domestic machine tools is only 40%. In many cases, the machines just stay idle. When there are large orders, the equipment cannot meet the needs. Second, information supply and demand are not sufficient. When a company has a large order and needs to purchase the CNC machine tool processing capacity, it does not know where the processing capacity is. Third, the manufacturing capacity is not measurable, and the capability transaction cost is relatively high. There is no transaction without measurement. With the equipment on the cloud, manufacturing capabilities can be released online, manufacturing

resources can be flexible, supply and demand information can be butted in real time, and capacity transactions can be accurately billing. This provides a possible solution to the above problems.

2.3.3 Rely on cloud ecology to accelerate knowledge reuse

Cloud ecology has brought about the spread, reuse, and reconstruction of industrial knowledge. Precipitation refers to the solid encapsulation of industrial technology, experience, knowledge, and best practices into micro-service components and industrial APPs. Reuse refers to repeated calls to micro-service components and applications. Reconstruction refers to the construction of a new system of industrial knowledge creation and dissemination, an innovative body (integrating third-party resources efficiently and conveniently), innovative carriers (recallable micro-services and APPs), and innovative approaches (based on industrial PaaS platform and industrial APP innovation system) will change, which will greatly reduce the cost and risk of innovation, increase the efficiency of research and development, and will change the “80/20 rule” (ie, 80% of the energy is spent on repetitive labor, 20% is used in Creation), 80% of the energy is devoted to creation, and 20% to repetitive labor.

The manufacturing ecology of data aggregation, analysis and service based on cloud platform improves the status monitoring, prediction, prediction, performance optimization and production

capacity of industrial equipment. In the guidance of the State Council on deepening the Internet + advanced manufacturing industry, the guidance of the development of industrial Internet has proposed to promote the cloud of millions of enterprises. In this process, a number of high-throughput, high value industrial platforms and industrial APP are becoming the leading application of industrial cloud ecological development, and also the foundation of the current industrial Internet platform construction. According to Moore's law, the cost of the enterprise to use digital technology will be lower and lower, and the threshold is getting lower and lower. It is not to build a complete information system, but through the way of buying service, it can easily realize the digital process of the enterprise through the way of cloud and APP.

In summary, the development of smart manufacturing is divided into three cores. Industrial big data is the foundation, industrial Internet of things is the support, and industrial intelligence is the goal. Intelligent manufacturing is like a big tree, as shown in Figure5. First, the root of big data digitalizes people, equipment, and other production objects. If a tree is to thrive, it must be extracted from roots. Nutrients, empathy, and intelligent manufacturing must be filled with vital data and nutrients if they are to be full of vitality; then edge calculations are like the trunks of big trees. The branches themselves need to be processed and absorbed. Part of the nutrition, but also play a role in the further upward transmission of nutrients,

the same reason, in the industrial field of those real-time requirements of strong data, must be processed directly by the edge of the local equipment, the rest of the transmission to the cloud, for further complex Analysis, and thus through the connection to the network to achieve the value of the data flow; Finally, the application is like the leaves and fruits of the big tree, collecting and analyzing data is only a process, to obtain insights from the data, and to provide services through the application of software is purpose. The analysis results can be further fed back to the equipment side to help the continuous improvement of the production process. The entire tree uses data as a factor of production to create economic value for manufacturing through industrial cloud-based artificial intelligence.

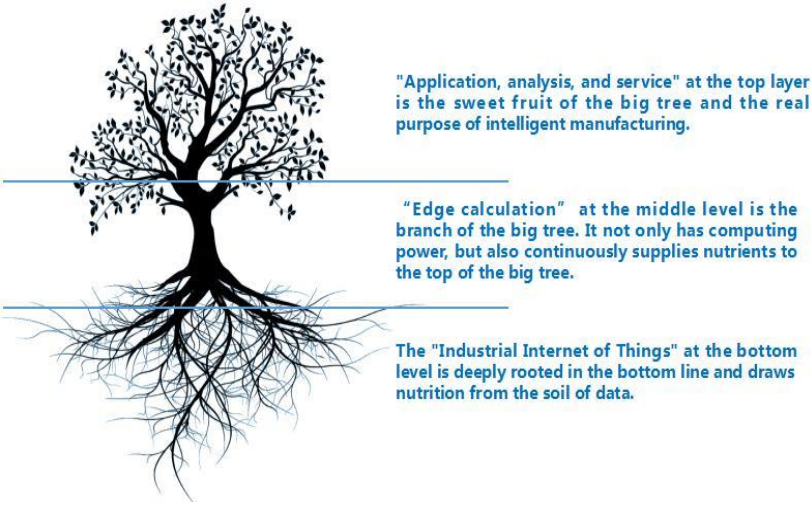

Figure5 Three Cores of Intelligent Manufacturing

3 Use the new generation of information technology to transform and upgrade traditional industries

The deep integration of the new generation of information technology and manufacturing industry will reshape the whole life cycle of the products of design, manufacture, service and so on. It will bring about new technologies, new products, new formats, new models, and profoundly influence and change the production structure, mode of production and even life style and thinking mode of human beings to achieve the overall upgrading of social productivity. In China, manufacturing industry has a strong demand for intelligent upgrading, but on the whole, the foundation of China's intelligent manufacturing is pretty weak. Faced with such a situation, how will we promote technological transformation and intelligent upgrading of traditional industries?

3.1 Speed up the development of intelligent infrastructure

There are two main aspects of realizing intelligent manufacturing. One is industrial manufacturing technology, including advanced equipment, advanced materials and advanced technology. This is the basis for determining the manufacturing boundary and manufacturing capability. The other is intelligent infrastructure, which is the new generation based on the Internet of Things, the Internet, cloud computing, Big data, artificial intelligence and so on. Information technology gives full play to the potential of industrial

equipment, technology and materials, improves production efficiency, optimizes the efficiency of resource allocation, creates differentiated products and realizes the value-added service. In short the infrastructure of industrial intelligence provides an important support for the intelligent development of modern industry.

Whether the "industrial Internet", represented by GE in the United States, or the "Industrial 4.0" strategy represented by SIEMENS in Germany, its essence is to promote the intelligent transformation of the industrial system by the new generation of information technology represented by Internet, Internet of Things, cloud computing, big data, artificial intelligence and so on. In the strategic planning of "Made in China 2025", it is clearly proposed to "accelerate the integration of the new generation of information technology and manufacturing technology and take intelligent manufacturing as the main direction of in-depth integration of the two. We will focus on the development of intelligent equipment and intelligent products, and promote the intelligent production process, cultivate new production methods, and comprehensively increase the level of intelligence in R&D, production, management, and services." Therefore, it is extremely urgent to accelerate the development of next-generation information technologies such as Internet of Things, cloud computing, big data, and artificial intelligence. However, the industrial base of our country is still in the weak stage of intelligence, especially the level of the enterprise is

uneven. The realization of the intelligent transformation can not be made "one size fits all". The enterprises, especially the small and medium enterprises, should combine the enterprise development with the actual situation, fully consider the balance of technology advanced and technical economic, and apply it to the practical and realistic application. China's transformation and upgrading of technology path, according to the different regions and development stages of enterprises, China needs to develop 2, 3 and 4 strategies in parallel. Key regions and industries should select key enterprises and champion the promotion of digital technologies, system integration technologies, key technology and equipment, and intelligent manufacturing equipment. Pilot demonstrations demonstrate new models, including decentralized intelligent manufacturing, process intelligence manufacturing, and networked collaborative manufacturing. Mass customization and remote operation and maintenance services are provided for smart shop/plant construction, enabling companies to continuously nurture, improve, and promote new intelligent manufacturing models. Therefore, we must organize and develop R&D, including new sensors, smart measurement instruments and other industrial Internet of Things, and develop core computing devices with depth perception, intelligent decision-making, and automatic execution functions, and industrial clouds and clouds with multiple-source heterogeneous access capabilities and cloud ecology, so as to build their own intelligent

infrastructure and promote engineering and industrialization according to the actual situation.

3.2 Explore value of production value data in industries

With the deep integration of informatization and industrialization, information technology has penetrated into every link of the industrial chain of industrial enterprises Bar-codes, two-dimensional codes, RFID, industrial sensors, industrial automation systems, industrial Internet of Things, ERP, CAD/CAM/CAE/ CAI and other technologies are widely used in industrial enterprises, especially in the application of new generation of information technology such as the Internet, mobile Internet, and Internet of Things. Industrial enterprises have increasingly richer data than ever before. Big data itself is worthless. Big data is of no value in itself. The significance of big data lies in big data mining and analyzing, problems finding, problems solving, problems avoidance and processes optimization. In other words, the industrial big data is the core of intelligent manufacturing technology, through the analysis of data we can forecast demand, predict, solve and avoid the risk of invisible problem, and we can integrate industry chain and value chain by making full use of the data.

At the same time, the production lines in industrial enterprises are operating at a high speed. The amount of data generated, collected, and processed by industrial equipment is far greater than the data

generated by computers and labor in enterprises. The data types are mostly unstructured data. The high-speed operation of production lines. The high-speed operation of the production lines is also more demanding for the real-time data. How to use the Internet of Things technology to effectively collect industrial big data, and at the same time to strengthen information management and services through mining, so as to master the production and sales process, correctly handle bottlenecks, and improve the controllability of the production process, has become the key.

At present, despite the abundance of industrial big data, industrial big data has not yet been fully utilized due to the lack of effective analytical tools and efficient computing techniques to extract useful information. Most of the factories mainly compress data and archive data for a short period of time. They only perform data recovery and analysis under special operating conditions, instead of using historic data as assets for the general decision-making process like Amazon and Google in the consumer field. The challenge of industrial big data lies in mining the knowledge contained in historical big data, but knowledge is not presented directly in the data, but in the model used to reveal the data. As shown in Figure 6, the prediction model and the optimization model are established through historical data, and the key values in the prediction model are related to the optimization model, so that the control parameters are derived and sent to the workers and equipment, which are produced in the

production process. The actual data is fed back to the forecasting model and the optimization model to continuously optimize and guide the production. Therefore, it is very important to establish an effective industrial data model. The industrial big data model mainly includes fault diagnosis and prediction model, industrial production line analysis model, industrial enterprise supply chain optimization model and product precision marketing model and many other aspects.

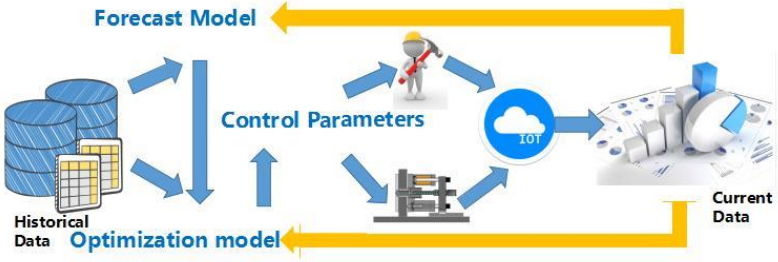

Figure6 Industrial Data Model

Intelligent manufacturing without data support is a castle in the air. As shown in Figure 7, we are acquiring data from cross-object and equipment and analyzing and predicting data streams to achieve the three functions: grasping the present, analyzing history, and predicting the future. Traditional enterprises should take the initiative to grasp the development direction of big data, establish industrial data models according to the characteristics of different industries, dig deep into the value of big data within the industry, effectively use data to improve and automation, make decisions, forecast, analyze

demand preferences, and improve production and process, and optimize industrial output.

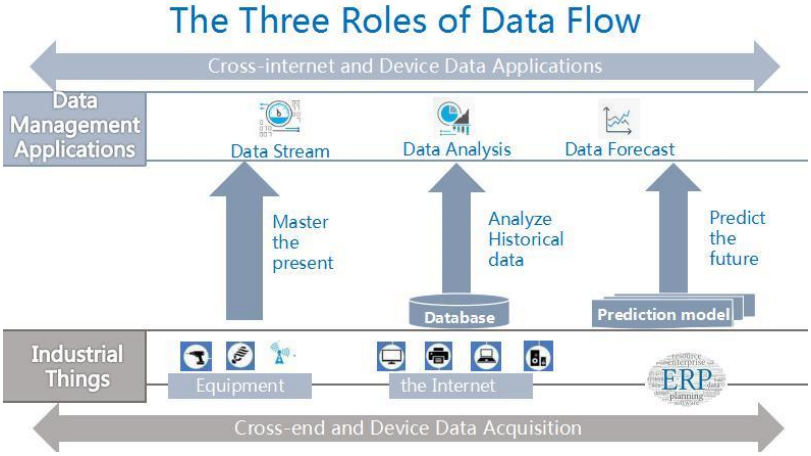

Figure7 The Role of Industrial Big Data

3.3 Building an industrial chain ecosystem with "building blocks innovation"

True intelligent manufacturing is not advanced automation, but the innovation of the industrial chain ecosystem based on data. Its goal is to quickly respond to continuously changing market demands, to build a customized and flexible new production system, and to form a complete industrial chain ecosystem, and build up cost fine management capabilities. In order to complete this process, it is necessary to integrate various information in the production process, including users, raw materials, production equipment, intellectual resources, logistics and transportation, to achieve overall parallel

organization and collaborative optimization. From the design, research and development to distribution and services, this process is long and cumbersome. How to use the innovation system to speed up the construction of the industrial industrial chain is a key issue that needs to be resolved.

"Building block innovation" refers to the combination of different elements like "building blocks" in the process of innovation.Building block innovation collaborative manufacturing is mainly used in equipment manufacturing, through parallel organization of the production process of mechanical products, including design, r&d, manufacturing and logistics, efficiency and quality of products. The core idea of building blocks innovation is to use the Internet and big data to organize social resources so that products and services can be obtained at high speed, high quality and low cost in the market. Building block innovation to build industry full of industrial ecological system helps to speed up the diversification of production resources effective coordination, promote industrial chain resources integration, accelerating manufacturing network formed industrial ecosystem.

The use of one' edge to break through one by one and form a block-based technology model that can be plugged in, contributes to the construction of a product life cycle online analysis and optimization capability, fosters new forms of business such as networked collaboration, shared manufacturing, and service-oriented

manufacturing. It uses new technologies, new formats, and new models to promote the transformation of traditional industries' production, management and marketing models, and supports technological transformation in a variety of ways. Constructing industrial eco-industrial chain ecosystem based on building blocks can enable data from production processes, internal management, and consumer markets to move, enabling borderless information flow and big data analysis. Relying on emerging information technologies such as cloud computing, big data, internet of things, and mobile internet, all aspects of R&D, production, logistics, marketing, and sales are unified on the smart data platform. We can use powerful computing to mine in massive valuable data, comprehensively build an industrial whole industrial chain ecosystem.

The above points of view solve three problems: what is the trend of a new generation of information technology and manufacturing in-depth integration, what to do in order to better develop intelligent manufacturing technology, and what to do in order to achieve the transformation and upgrading of traditional industries. In the context of the upcoming new round of scientific and technological revolutions and industrial changes, and our country’s accelerating transformation of economic development patterns, in the context of “Made in China 2025” and Industry 4.0, it provided us with a rare opportunity for implementing innovation-driven development

strategies. Looking globally, the world is currently at the "entrance" of the 4th industrial revolution. China and the United States and other developed countries are basically on the same starting line. Whether this historical opportunity can be seized is a key move for the Chinese nation to realize its great rejuvenation and return to the top of the world.

Research Team

Liu Jing, School of Artificial Intelligence and Data Science, Hebei University of Technology. Deputy director and researcher, Hebei Key Laboratory of Big Data Computing

Dong Yongfeng, Associate Dean and Professor, School of AI and data science, Hebei University of Technology

Ji Haipeng, Associate Professor, School of Materials, Hebei University of Technology

Yan Wen Jie, Lecturer, School of Artificial Intelligence and Data Science, Hebei University of Technology

Dong Yao, Lecturer, School of Artificial Intelligence and Data Science, Hebei University of Technology

Wang Jingxin, Lecturer, School of Artificial Intelligence and Data Science, Hebei University of Technology

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