

# Thinking on the integration of 5G and industrial applications

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**Abstract:** *With the rapid development of 5G technology, new breakthroughs have been made in artificial intelligence, Internet of Things, cloud computing and other fields, and new development opportunities have also been brought to industries such as medical and industrial manufacturing. This article discusses the thinking of 5G and industrial convergence applications. 5G technology has great potential in the field of industrial manufacturing, but there are also challenges such as the need to strengthen the digital transformation of industrial infrastructure, equipment compatibility and standardization, and the lack of effective demand-pull power. Solving these challenges requires the joint efforts of all parties to promote the development of 5G in the industrial field and achieve intelligent and digital transformation.*

**Keywords:** *5G technology; industrial convergence; Challenge; development*

## 1. Introduction

With the rapid development of 5G technology, its integration and application with the industrial Internet has become a hot topic in current research. This paper will discuss the challenges and problems of 5G and industrial integration application by analyzing the status, application characteristics and advantages of 5G technology in industrial applications, so as to discuss the strategies of 5G and industrial integration applications, in order to provide valuable thinking and guidance for research and practice in related fields, promoting the further development of 5G and industrial integration applications, industrial intelligence and digital transformation<sup>[1-3]</sup>.

## 2. The current situation of 5G and industrial convergence applications

At present, 5G and industrial integration applications have made certain progress. At home and abroad, cooperative relations have been established between operators, communication equipment manufacturers and industrial enterprises, and many 5G application innovation research centers and laboratories have been established. At the same time, some star enterprises such as Shanghai Aircraft Manufacturing Co., Ltd., Qingdao Port, Sany Heavy Industry, Gree, China Southern Power Grid, etc. have also achieved outstanding results in the field of 5G and industrial Internet integration. These enterprises have realized the flexibility of production lines and intelligent production through the use of 5G technology, and promoted the transformation of industry to intelligence, service, and high-end<sup>[4-5]</sup>.

### 2.1 A large number of 5G industrial integration star enterprises have emerged

In the early stage of 5G technical standard formulation, industrial applications are the focus of 5G demand research. 5G's low-latency and high-reliability technology is designed to meet the needs of industrial real-time control, unmanned driving and other applications. With the pre-commercial use of 5G equipment, domestic and foreign operators and communication equipment manufacturers have cooperated with industrial enterprises, established a series of 5G application innovation research centers, and carried out a large number of research and experiments on the integration of 5G and industrial applications. At present, 5 5G network transformation and promotion service platforms have been formed in the country, and dozens of 5G application innovation centers or laboratories have been formed by the three major operators, and a large number of 5G and industrial Internet integration star enterprises have emerged<sup>[6-8]</sup>.

## ***2.2 Revolutionize the way of organizing industrial enterprises***

As a new generation of mobile communication system, 5G technology has transmission rates of more than 100 Gigabits, millisecond-level delays, and high reliability. These characteristics enable 5G to be integrated with all aspects of industry, providing industrial enterprises with tools for flexible production lines and intelligent production, and also providing means for industrial enterprises to connect with users and supply chains, promoting the transformation of industry to intelligence, service, and high-end. Through 5G technology, it is to realize the all-round interconnection of personnel, equipment and environment and remote real-time control of production equipment, promoting the development of industrial production in the direction of unmanned, networked, intelligent and collaborative. For example, Qingdao Port uses 5G to realize the remote operation of shore cranes, effectively improving the working environment of employees, saving labor costs, and promoting the realization of unmanned terminals. Hangzhou Steam Turbine uses 5G+3D modeling to realize intelligent product quality inspection and improve the efficiency of blade quality inspection<sup>[9-10]</sup>.

## ***2.3 The production and operation mode of industrial enterprises has been transformed***

On the other hand, 5G technology has also promoted changes in the production and operation models of industrial enterprises. Through the combination of 5G technology and its own products, industrial enterprises have obtained the entrance to interact with customers, and through all-round monitoring or control of product status. They can provide customers with more targeted personalized services, which has promoted the transformation and upgrading of industrial enterprises from production-oriented enterprises to service-oriented enterprises. For example, Guangxi Liugong uses 5G+MEC to realize high-efficiency and low-latency remote control of loaders and monitoring of the working environment, thereby realizing a variety of business models, including leasing equipment and value-added services, and realizing the transformation of enterprises from equipment manufacturers to service providers<sup>[11-13]</sup>.

## **3. 5G application characteristics and advantages in the industrial field**

The application of 5G in the industrial field has many advantages, which can promote the intelligent development of the industrial field and improve production efficiency and quality.

### ***3.1 High speed and large connectivity***

The high speed and large connectivity of 5G enable fast and stable data transmission and communication between industrial equipment. Traditional industrial communication technologies are often limited by bandwidth and number of connections, but 5G can provide higher data transmission rates and more connections, which can meet the needs of industrial production for large-scale data transmission and processing. For example, in industrial automation production lines, various sensors, controllers and robots can transmit and share data in real time through 5G networks to achieve refined production management and collaborative control, and improve production efficiency and quality<sup>[14-16]</sup>.

### ***3.2 Real-time and high reliability***

The low latency of 5G makes communication between industrial devices more reliable in real time. In the industrial field, many application scenarios have extremely high requirements for real-time and reliability of communication, such as remote operation of industrial robots and real-time monitoring and control of industrial Internet of Things. 5G's ultra-reliable low-latency communication (URLLC) technology can achieve millisecond-level latency and high-reliability communication, ensure the stability and timeliness of communication between industrial equipment, and improve production efficiency and safety.

### ***3.3 Customized network services are available***

5G network slicing technology can provide customized network services according to different industrial application scenarios. The application scenarios in the industrial field are diverse, and the demand for network services is also different. Through 5G network slicing technology, a physical network can be cut into multiple virtual sub-networks to provide customized network services for different industrial applications. For example, in industrial automation production lines, the demand for

real-time communication is higher, and low-latency network services can be provided; In the field of logistics management, large-scale data transmission and processing needs can provide high-bandwidth network services. For example, in industrial automation production lines, the demand for real-time communication is higher, and low-latency network services can be provided; In the field of logistics management, large-scale data transmission and processing needs can provide high-bandwidth network services. Such customized network services can meet the specific needs of the industrial field and improve the refined management and efficiency of industrial production<sup>[17-20]</sup>.

### ***3.4 With delay jitter and determinism***

5G also has the characteristics of delay jitter and determinism, which can meet the deterministic requirements of communication delay in the industrial field. In the industrial production process, the delay of each delivery of the same instruction needs to be consistent to ensure the synchronous operation and interoperability of industrial equipment. Through 5G time tag technology and control technology, communication delay jitter can be controlled to the microsecond level, ensuring the sequential transmission and reception of messages, and ensuring the stability and reliability of industrial field networks.

## **4. The challenges of 5G in industrial manufacturing**

### ***4.1 The digital transformation of industrial infrastructure needs to be strengthened***

The integration of 5G and industrial manufacturing requires the digital transformation of production equipment. However, at present, most Chinese enterprises are facing difficulties in digital infrastructure renewal in digital transformation, and the digitization rate of industrial production equipment is less than 50%. In order to achieve integration with 5G technology and promote the upgrading and transformation of industrial structure, we must accelerate the digital transformation of production equipment. This requires enterprises to make upfront cost investment and have a deep understanding of 5G technology, intelligent production and Industry 4.0<sup>[21-23]</sup>.

### ***4.2 Device compatibility issues***

There is a wide variety of devices in industrial manufacturing scenarios, often from different vendors, using different communication protocols and interfaces. Compatibility and integration of existing equipment with 5G networks is a complex task that requires equipment upgrades and adaptations to meet the interconnection with 5G networks. In addition, unified communication standards and interfaces need to be developed to facilitate interoperability and integration between devices.

### ***4.3 Lack of effective demand momentum***

In the field of industrial manufacturing, an important problem facing 5G is that enterprises believe that 5G applications lack commercial value, resulting in a lack of effective demand pull. The market is the driving force for the development of enterprises, and only by obtaining the return on investment of the market can a virtuous circle be formed. However, the current 5G application market is limited by the incomplete coverage of infrastructure, the reform rate of enterprises in the process of digital reform is low, the reform progress is slow, and the 5G technology integration requirements in some industrial fields are not clear enough, making 5G technology integration lack effective scenarios and application environments, and enterprise application requirements are low. At the same time, because the private network technology is not yet mature, enterprises have greater doubts about increasing investment to achieve integration with 5G, which also limits the application of 5G technology in industrial manufacturing<sup>[24-25]</sup>.

## **5. Application strategy of 5G technology in the industrial field**

Strengthening technology research and development is a key step in promoting the application of 5G in the industrial field. On the basis of 5G technology, we should focus on carrying out research and development related to industrial manufacturing, including the integration and application research of 5G and the Internet of Things, artificial intelligence, big data and other technologies. Through continuous technological innovation, improve the performance and reliability of 5G in industrial manufacturing to

meet the needs of industrial production. First, we must strengthen the research and development of 5G technology in the field of industrial manufacturing. This includes the optimization and improvement of 5G networks, improving network stability and transmission rates to meet the needs of high-speed, low-latency communication in industrial environments. At the same time, it is also necessary to study the integration of 5G with other key technologies, such as the Internet of Things, artificial intelligence and big data, to realize the intelligence and automation of industrial manufacturing. Second, we should strengthen applied research related to industrial manufacturing. Through cooperation with enterprises, research institutions, universities and other parties, we will jointly carry out innovative research and application practice of 5G in the field of industrial manufacturing. This includes research on the application of 5G in production line automation, remote control of equipment, logistics management, etc., to promote the intelligence and informatization of industrial manufacturing processes [26-27]. Third, it is necessary to strengthen personnel training and exchanges. Train and introduce professionals with application experience of 5G technology in the field of industrial manufacturing, establish a talent training mechanism, strengthen the training and learning of related technologies, and improve the professional level of practitioners. At the same time, we will strengthen exchanges and cooperation at home and abroad, learn from the experience and practices of other countries and regions in 5G industrial applications, and promote technology sharing and exchange. Fourth, we should strengthen the construction of industry standards. It is to develop and improve industry standards related to 5G in the field of industrial manufacturing, including standardization work on network communication standards, data transmission standards, security standards, etc. By establishing unified standards, promote interoperability between different manufacturers and devices, and promote the development of the industry and the popularization of applications [28-30].

### ***5.1 Use small and medium-sized enterprises as the main driving force for the improvement of 5G convergence demand***

Small and medium-sized enterprises play an important role in industrial production, and by strengthening the digital transformation of industrial production of small and medium-sized enterprises, and using small and medium-sized enterprises as the main driving force for the improvement of 5G integration demand, it can lay the foundation for the improvement of information reform demand in the entire industrial field. It is suggested that from the perspective of small and medium-sized enterprises, on the basis of enterprise digital manufacturing and industry platform service models, build a digital general contracting model and industry cloud platform development system, and further enhance the digital transformation of industrial production of small and medium-sized enterprises. The digital EPC model can improve the technological fragmentation of traditional industrial enterprises, create integrated production processes and standardized production management. The industry cloud platform development system can take advantage of the high speed and low latency of 5G technology to create a shared management solution and promote the full integration of 5G technology. Second, expand the 5G application market and build a service-oriented enterprise. The coverage of 5G technology in the industrial field can be improved by building industrial apps and establishing a cooperation model with the participation of multiple parties. Through pilot projects to promote the application of 5G intelligent modules in industrial production, gradually realize scale and integration, create an ecological development pattern of standardized design, mass production, and market-oriented configuration to provide a good environment for the full integration of 5G technology. In addition, with the flexibility and innovation of SMEs in industrial production, we can also deeply understand the actual needs of industrial production through cooperation with SMEs, and combine the characteristics of 5G technology to make it the main driving force for the improvement of 5G integration demand. It is to focus on 5G technology and AGV communication control, ultra-high-definition video, machine vision, remote operation and maintenance and other integration fields, promote the automation and intelligence of industrial production, carry out business landing through demonstration projects, and create new 5G commercial application value and application models.

### ***5.2 Building 5G service promotion model innovation***

It is building 5G service promotion model innovation is the key to achieving the wide application and development of 5G technology in the industrial field. By combining the advantages of 5G technology for specific industrial production scenarios, we can create a targeted business promotion model and promote intelligence and informatization in the industrial field. On the one hand, according to the specific needs and scenarios of the industrial production process, a specific business promotion model can be established. For example, combined with remote operation and maintenance and machine vision

technology of mobile device inspection and automatic control, applications such as intelligent logistics, automated equipment maintenance system and operation positioning system can be built. These models can increase the level of automation of industrial production, improve production efficiency and quality. Through pilot projects in specific industrial production scenarios, the application effect of 5G technology in the industrial field is verified, and the new 5G commercial application value and application mode are further explored. This can gradually promote the expansion and deepening of the application of 5G technology in industrial production. On the other hand, it can combine the interactivity of 5G technology and industrial Internet to build a shared management scheme. Through the establishment of the industry cloud platform development system, the high speed and low latency advantages of 5G technology are used to realize the rapid transmission and sharing of industrial production information. At the same time, the integration of 5G technology can be implemented in combination with specific scenarios in the industrial production process. Through demonstration projects, we will further create new 5G commercial application value and application models. Through targeted business promotion models, demonstration projects and shared management solutions, the digital transformation of enterprise industrial production can be further enhanced, laying the foundation for the improvement of the demand for information reform in the overall industrial field, thereby promoting the wide application and development of 5G technology in industrial production, and realizing intelligence and informatization in the industrial field<sup>[31-32]</sup>.

## 6. Conclusion

At present, the integration of 5G and industrial applications is developing rapidly, and some outstanding results have been achieved. However, there are still some challenges to be solved in practical applications, which require the joint efforts of all parties to promote the wide application of 5G technology in the industrial field. With the further maturity of technology and the continuous expansion of application scenarios, it is believed that the integration of 5G and industrial applications will bring more opportunities and development space for industrial enterprises.

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