Research on the Path of Collaborative Innovation in Manufacturing Driven by Digital Economy
A Perspective of Guangdong-Hong Kong-Macao Greater Bay Area

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Abstract
Purpose: To enhance the innovativeness of the manufacturing sector, traditional manufacturing enterprises face the dilemma of choosing digital tools such as industrial Internet, artificial intelligence, and big data.
Design/methodology/approach: Meta-analysis was carried out on the digital economy and innovation in the desired location. In terms of the research area, Guangdong-Hong Kong - Macao Greater Bay Area（It may be abbreviated as GBA or Greater Bay Area） is not only a representative of China that can drive collaborative innovation in the manufacturing industry through a digital economy,but also currently the most productive industrial zone, at the peak of digital economic growth.
Findings: From the endogenous perspective, this study analyzes the path and mechanism of collaborative innovation of manufacturing enterprises driven by the digital economy, taking Guangdong-Hong Kong-Macao Greater Bay Area(GBA) as an example. It puts forward different assumptions about the collaborative innovation of manufacturing enterprises of different sizes in digital economy. Guided by the innovation goal, this paper gives the scheme of the digital transformation of manufacturing enterprises, analyzes the differentiation between above-scale industrial enterprises and SMEs, and reveals the difference of collaborative innovation effect of the digital economy on the manufacturing industry.
Originality/value: The digital economy and digital tools can promote collaborative innovation and high-quality development of manufacturing enterprises above scale by increasing innovation investment and increasing per capital profit. Through the development of the digital economy, promoting the transition and enhancement of digital services in the production sector can boost the productivity of the production sector.

Keywords: Collaborative Innovation, Digital Economy, Guangdong-Hong Kong-Macao Greater Bay Area

Classification: Case study

Introduction

The Guangdong-Hong Kong-Macao Great Bay Area, also known as The China Great Bay Area, includes 11 cities including Hong Kong, Shenzhen, Zhuhai, Macao ,and Guangzhou(Canton). It is one of the most affluent parts of China in terms of economy.The Guangdong-Hong Kong-Macao Greater Bay Area(GBA) has the highest concentration of economic activity and the most advanced level of digital technology in China's industrial sector. Additionally, it is the most dynamic and innovative region of the country in terms of economic growth. Its added value accounts for more than 46.8%, and Guangzhou(Canton) Digital Economy and Artificial Intelligence Pilot Zone have been built. The State Council of China pointed out in the opinions on the institutional mechanism of factor marketization in 2020 that "data, like land, labor, capital, technology, etc., are marketable production factors". Through the introduction of data production factors, the digital economy reconfigures the original resources and fosters the collaborative innovation of manufacturing firms within the industry and between industrial chains. Traditional manufacturing enterprises have the characteristics of a large transformation spans, serious technical barriers, low openness, high production costs, poor coordination among enterprises , and so on. There are many problems in the industry, such as repeated investment, homogeneous competition ,and closed technology, which hinder the development of enterprises. Disorderly competition among enterprises leads to internal innovation, and only a few monopoly enterprises can carry out collaborative innovation in the industrial chain.

Research Background

With the birth of digital technology, digital economy reshapes manufacturing resource allocation's traditional mode , changes the disordered competition among enterprises, and achieves the purpose of collaborative innovation. On the one hand, the industrial Internet, big data, etc. have been deeply integrated with the manufacturing industry and evolved into an industrial data platform. The members of the platform are interconnected and prosper. This has promoted innovation synergy among enterprises, spawned new technologies, transformed

disorderly competition among enterprises into orderly synergy, and improved innovation efficiency. On the other hand, intellectualization and cloud computing have interconnected the production of enterprises in the industrial chain. Carry out collaborative innovation across industries and fields to form high-quality collaborative innovation clusters. Digital economy is an important "upward trend" from disorderly steady state to collaborative steady state, but relevant studies have not revealed the impact of digital economy on Collaborative Innovation of manufacturing industry in Guangdong-Hong Kong-Macao Greater Bay Area. Based on this background, this study carries out normative analysis and Research on the mechanism, path and performance evaluation of collaborative innovation of manufacturing industry in Greater Bay Area(GBA) driven by digital economy.

In recent years, revamping traditional industries and the digitization process are accelerating. To enhance innovativeness, traditional manufacturing enterprises face the dilemma of choosing digital tools such as industrial Internet, artificial intelligent production and big data. On the one hand, collaborative innovation is constrained by digital tools; On the other hand, the innovation synergy among enterprises with different production scales is different. Therefore, the core value of this study is to provide collaborative innovation solutions with digital tools for above scale and small and medium-sized manufacturing enterprises respectively. It enables manufacturing enterprises with different production scales to make reasonable decisions, so as to achieve the purpose of collaborative innovation among enterprises and reduce costs.

Research Significance

At present, the digital economy is reshaping the global economic pattern as an absolute trend leader. In the context of the COVID-19 in our world, digital transformation's acceleration has brought about changes in world industries. In terms of theoretical significance, the advancement of digital administration in the manufacturing sector reflects the level of intelligent manufacturing industry in a country or region to a certain extent, and also represents the level of Intelligent Manufacturing in that country or region. With the continuous optimization of the structure of digital economy, its pulling effect on manufacturing management will become increasingly prominent. This paper will comprehensively study the specific path of collaborative innovation between digital economy and manufacturing industry through theory. The research results can provide reference and

further enrich the theoretical basis of digital economy for manufacturing enterprises in Greater Bay Area to choose digital transformation's appropriate direction .

In terms of application significance, Greater Bay Area is one of China's manufacturing Highlands, with some industries leading the whole country and complete industrial chain. As an important manufacturing distribution center in China, Guangdong-Hong Kong-Macao Greater Bay Area gathers leading enterprises in many industries. However, the various levels of digital economy progress in multiple cities within the region are not unified, and the spatial agglomeration of manufacturing industry in the East is significantly stronger than that in the west, especially in Shenzhen, Guangzhou(Canton), Dongguan, Foshan, Huizhou and other cities, where most of the manufacturing industry in the region is concentrated.

Literature Review

The research on collaborative innovation driven by the digital economy mainly focuses on the research of digital economy and collaborative innovation, and a few studies include digital tools into the framework of collaborative innovation.

Digital Economy Promotes the Development of Manufacturing Industry

The digital economy can be described as a novel arrangement of the production components, which are made up of digital information, an information network, and the real economy.

With the development of practice, Ma Shuzhong et al. (2018) analyzed that the connotation of digital trade is also changing and expanding. By harnessing digital data and communication technology to facilitate the swift exchange of tangible goods, digital products and services, data and information, we can foster the transition from consumer-based internet to industry-based internet, resulting in the emergence of smart manufacturing trade activities, which is an extension of traditional commerce in the digital economy era. So far, digital trade is no longer limited to the field of the Internet, but has spread to the field of traditional industry. Intelligent manufacturing has become one of the development trends of digital trade. The existing research paradigm of digital economy has defects. Many studies are limited to macro concepts such as framework research, industrial chain and value chain research, causal empirical research, and there are few research articles on micro market players. The research paradigm of digital economy includes value exploration, application

exploration and future outlook. Of course, this is connected to the fledgling exploration of digital economy. As a new concept, its theoretical development generally follows the operation law of superstructure, and its shortcomings are understandable.

In comparison with other countries, Liu Jiaqi et al. (2022) believe that the digital economy can promote high-quality economic growth. Lizongming (2021) believes that the digital economy can accelerate the innovation and development of the region and guide the upgrading and transformation of traditional industries. In terms of manufacturing enterprises, Wei Zhuangyu (2022) believes that digital economy can optimize the allocation of manufacturing enterprise resources. Zhang Lingjie et al. (2022) believe that digital economy can foster total factor productivity of manufacturing industry's improvement . From the perspective of digital economy and innovation, Wang Zhixin (2020) demonstrated that financial innovation will foster digital economy's development by creation effect. Liang Xiaotian et al. (2022) believed that digital industrialization, industrial digitalization and digital coupling development can significantly promote the high-quality development of manufacturing industry. The digital economy has brought more emerging technologies, and through the integration of big computing power and big data, it has promoted the transformation of digital factors into production factors, promoted the coupling development of digital industrialization and industrial digitalization, and promoted the high-quality development of manufacturing industry.

Ghobakhloo,M. & Fathi,M.(2020)believes that the Industry 4.0 transformation of small manufacturing enterprises can start with the digitalization of certain operational areas and use digitalization to support the core organizational strategy. The creation of a lean digital manufacturing system can serve as a practical business approach for sustaining enterprise success in Industry 4.0 environment.Yi Luxia et al. (2021) also found through empirical results that enterprises' digital transformation has improved main businesses' performance level . The relevant mechanism test found that enterprise can significantly enhance its primary operations from the four dimensions of internal governance, financial stability, information optimization and innovation potential. From the perspective of external factors, when enterprises face high economic policy uncertainty, digital transformation has a stronger performance driving force. At the same time, it also has a great impact on the traditional corporate governance model. The adaptive innovation of business model driven by digital

technology innovation makes enterprise business more complex and poses new challenges to the management and control of corporate governance risks. Meng Fanglin (2020) confirms that digital economy is an effective interaction between the new economy, new enterprises and new technologies, and its development cannot be separated from various central enterprises, digital populations and value communities, as well as digital talents. Li Xiaohua (2019) believes that digital economy is a new driving force, which can promote the transfer of industrial structure from labor-intensive and heavy industry to high-tech and environment-friendly industrial structure.

Digital economy involves a wide range of industries, and many scholars believe that it is an innovative economic model. and integrated economy. Through systematically combing the existing relevant research, it is found that previous research has primarily concentrated on the connotation and characteristics of the digital economy, the opportunities and challenges of the digital transformation of manufacturing industry, while the research on the path of the digital transformation of manufacturing industry under the background of the digital economy is relatively few, mostly staying at the perspective interpretation level of a certain aspect, lacking systematic discussion. Only by organically combining innovation resources (including digital resources), innovation environment and policy tools to analyze the digitization of production, can it conform to scientific analysis logic and form reasonable research results.

Collaborative Innovation Between Digital Economy And Manufacturing Industry

Collaborative innovation refers to the long-span resource integration and innovation mode carried out by enterprises and other organizations to achieve major scientific and technological innovation. All enterprises exploit their strengths, complement each other's resources, accelerate the application of technology and carry out scientific and technological innovation in a coordinated manner.

In recent years, international competition has been fierce. Huang Hongbin (2016) believes that the cooperation within the industry tends to be closer, and the traditional manufacturing industry must take the lead in the competition through collaborative innovation mode. Digital technology provides tools for resource sharing. Therefore, the author believes that digital economy is the internal driving force of collaborative innovation. In B2B research, Choe, j.-

m (2018) believed that the fit between the use level of B2B and the form of MCS can enhancing company supply chain productivity. His research believes that analyzing the influence of supply chain productivity on the firm's general success, E-commerce has had a positive impact. A direct correlation exists between improving supply chain performance and enhancing overall organizational performance.The findings of group analysis suggest that the management control system partially recognizes the role of promoting organizational resource capabilities, senior management support, supplier pressure, and the ability to develop appropriate forms in the case of high E-commerce adoption.

Zhao Liang et al. (2017) studied the application, transformation and upgrading of E-commerce and information technology in the manufacturing industry. They believe that with the development of big data, cloud computing, Internet of things and other technologies, the manufacturing industry is evolving from automation to intelligence, and personalized customization for users has become possible. Using Internet thinking to actively develop the application mode of digitalization in manufacturing enterprises make a significant contribution in the transformation and upgrading of manufacturing industry and encourage the shift in manufacturing methods to generate more opportunity for product export revenues.In the fourth industrial revolution, clients are the focus of businesses, and consumer-to-business will be the most prominent mode of online shopping in manufacturing industry in the future. This study combs the basic modes of E-commerce and information technology application in manufacturing enterprises, points out the existing problems, and puts forward corresponding countermeasures. Chari,A. et al. (2021) concludes that the Swedish manufacturing industry is on track towards achieving sustainable transformation by adopting essential resilience capabilities from facilitators according to Industry 4.0. Manufacturing needs to proactively embrace these capabilities to tackle the ever-growing and unpredictable sustainability concerns facing the world and successfully transition to a digital future for manufacturing sustainability.

Alderete, M.V. (2019) analyzed the contribution of E-commerce and information technology to the achievement of SMEs: structural equation model. She believes that through the research on the samples of manufacturing enterprises, it is found that the adoption of E-commerce has a significant positive impact on the sales of SMEs, and the use level of ICT has further strengthened this impact. Pedro Lorca et al. (2019) studied the impact of E-

commerce sales on the profitability and income of manufacturing enterprises. In an eight year study (2008-2015), they analyzed 2544 Spanish manufacturing companies. According to their research results, neither B2B nor B2C E-commerce seems to have an impact on income growth. Therefore, there may be substitution effect between physical channel sales and E-commerce sales. However, the author finds evidence that the profitability of companies adopting advanced E-commerce has increased significantly. In addition, if enterprises only adopt B2B or B2C, they will achieve a positive impact on profitability next year when measuring the status of E-commerce.

With the beginning of the digital revolution, the manufacturing industry is undergoing unprecedented changes. As innovation points, information technologies will fully integrate all links of manufacturing operation and management, and finally achieve the goal of upgrading the manufacturing industry. Digital transformation is becoming the general trend of manufacturing development.

Development of Digital Economy in Guangdong-Hong Kong-Macao Greater Bay Area

In terms of digital economy driven development in Guangdong-Hong Kong -Macao Greater Bay Area; Wan Xiaoqiong et al. (2022) pointed out that the digital economy promotes the high-quality development of Guangdong-Hong Kong-Macao Greater Bay Area through market demand's release and value chain's reconstruction . Based on the grounded theory, Yu Feifei et al. (2022) demonstrated digital economy's effect on regional innovation drive from three aspects: innovation subject, process and result. Liu Jing (2022) believes that data resources such as industrial big data, industrial big data, urban big data and government big data of world-class factories should be integrated to start and compete with developed countries or regions at the same time, so as to build a highly interconnected digital world and make it a leader and framework for the progress of global digital commerce. Zhou quanxiong (2022) believed that we should fully understand the importance and urgency of he flourishing of the manufacturing sector, expand and strengthen strategic pillar industries and strategic emerging industries, continue to enhance the independent innovation ability of manufacturing industry, create a premier high-tech manufacturing industry cluster, smooth the international and domestic circulation, promote the manufacturing industry to accelerate its progress towards the middle and high end of the global value chain, and enhance the voice and

competitiveness of Greater Bay Area in the high-quality development of global manufacturing industry.

Zhu wenbohao et al. (2021) analyzed that at the urban level,cities' digital economy in Greater Bay Area presents different situations. Guangzhou(Canton) has always regarded "a leading city in digital economy innovation" as its main goal, and has improved its digital economy development level through digital elements' flow, industry's reform and digital core technology's support. It is at the leading level in China's digital economy segmentation in many industries, such as ultra-high definition video, advanced telecommunications and satellite navigation, intelligent apparatus, machine learning, software and data services. Shenzhen is superior in digital people's livelihood and digital government affairs, especially in the digital application level of education payment and transportation payment; According to the plan of Guangdong Province in China, Huizhou and Zhaoqing belong to the master plan of "double core and nine centers", and the industrial digital transformation is in the early stage of construction. Zhuhai has advantages in cross-border service digitalization and digital payment; Foshan is located in the relative center of Dawan District, with a good industrial foundation and strong manufacturing level, and has great potential in digital industrialization and industrial digitalization; Dongguan's electronic information manufacturing industry has a good foundation. In recent years,Dongguan is the prefecture level city with the highest concentration of high-tech enterprises in all of China. Also,Dongguan has taken the development of industrial parks with digital industry agglomeration effect and the promotion of 5g industrial Internet as its main focus on the development path of digital economy. But Zhongshan and Jiangmen have a large gap with other nine cities in Greater Bay Area, and need to be strengthened in digital infrastructure's construction and industrial Internet and professionals' training in digital economy.

To sum up, the existing research has a perfect demonstration of the theory of digital economy and collaborative innovation, but the relevant literature analyzing the collaborative innovation of regional manufacturing driven by digital economy is still relatively few. It is mainly manifested in that the existing literature focuses on the resource integration effect or economic growth effect of innovation, ignoring the analysis of the internal mechanism of innovation and the driving factors of innovation. Secondly, the existing literature focuses on

innovation of digital economy within firms, while ignoring the resource allocation and collaborative innovation of digital economy among enterprises.

The Development of Integrated Model

In the traditional economic growth path, innovation behavior is jointly determined by the input of production factors such as resources and technology and market structure. These factors of production have formed a dynamic general equilibrium of multiple sectors in the market, making the collaborative innovation state maintain a steady state. With the development of information technology revolution, digital elements have emerged and become an indispensable part of production factors. At this time, the innovation behavior is jointly determined by traditional production factors such as resources and technology, digital production factors and market structure. The market structure and production factors have changed significantly and reconstructed into a new innovation steady state. Digital elements are an important driving factor for the transformation of innovation behavior from the old steady state to the new steady state, which can be considered as the rise of collaborative innovation. This study focuses on the impact of digital elements on the collaborative innovation drive of manufacturing industry.

Integrated Model

Taking the manufacturing industry in Greater Bay Area as the research object, through digital economy's investigation and collaborative innovation, this paper underscores the influence of digital economy on manufacturing collaborative innovation, analyzes its impact direction and action mechanism, and verifies it with empirical materials. First, it analyzes the role of digital economy in the process of manufacturing enterprises' disorderly competition turning to orderly collaboration. Secondly, the basic assumptions are derived according to the theory, and the regression equations are established by using the survey data. Thirdly, it compares the digital economy and collaborative innovation of manufacturing enterprises with different production scales, and draws statistical conclusions to verify the premise assumptions. Finally, guided by collaborative innovation, this paper gives countermeasures and suggestions for the digital transformation of business travel alienation.

First, starting from the research background, sort out the existing literature, clarify the purpose, content and methods of the research, and put forward the research question: does the

digital economy drive the collaborative innovation of manufacturing industry in Guangdong-Hong Kong-Macao Greater Bay Area. Second, theoretical analysis: define the scope of research and related concepts. Based on the self-organizing collaborative innovation theory and technological innovation theory, compare and analyze the differences between the collaborative innovation mode of digital manufacturing industry and the traditional collaborative innovation mode of manufacturing industry. Through the research, the path of collaborative innovation in manufacturing driven by digital economy is obtained. Third, discussion: Based on field survey data, questionnaire survey data and database data, analyze the rational decision-making of enterprise collaborative innovation from the perspective of digital economy. Through relevant research, it is suggested that manufacturing enterprises develop and promote advanced and applicable digital solutions around resource sharing, collaborative manufacturing, scene co construction and other aspects. It creatively regards the elements of digital economy as production factors, introduces the elements of manufacturing enterprises to study, and reveals the actual demand of manufacturing industry for the elements of digital economy. The cost management of some traditional manufacturing enterprises in Guangdong-Hong Kong-Macao Greater Bay Area needs to be optimized. Data collaboration cannot be achieved from the processes of marketing management, production management, warehouse management, product design management, etc., resulting in high enterprise costs,so manufacturing enterprises need to use digitalization to optimize these management. Fourth, conclusion: use the research conclusion to put forward policy suggestions for enterprise collaborative innovation and digital transformation. And summarize the research, analyze the shortcomings of the research and the direction of further research.
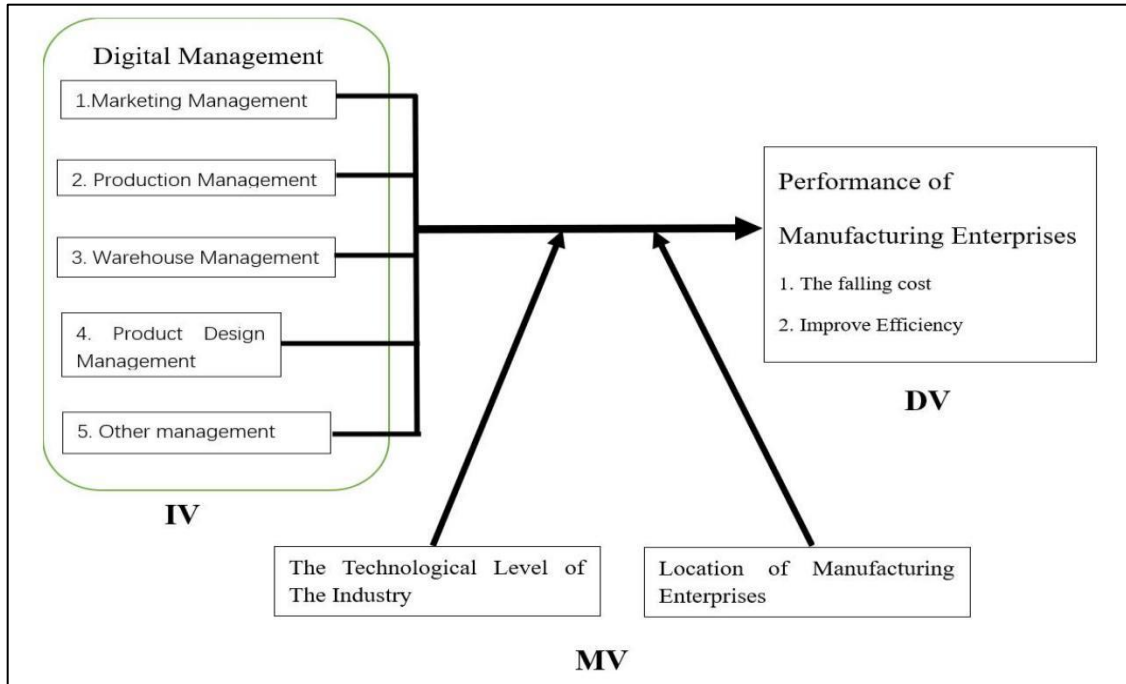
Figure 1: An Integrated Model of Digital Economy in

Guangdong-Hong Kong-Macao Greater Bay Area

Manufacturing enterprises need to adjust costs appropriately through digitalization and optimize the response speed of the supply chain. In combination with the enterprise cost management process, we can consider setting the cost in the long-term operation process in combination with the actual production consumption, and controlling it through digital management to reduce the cost difference of the enterprise. In the process of cost management, manufacturing enterprises should strictly follow the requirements of digital platform feedback, appropriately increase the cost accounting of new product development, adopt a special digital platform, reasonably allocate labor costs, material costs, transportation costs, etc., and realize digital cost management. In terms of regulatory variables, scientific and technological level affects their digital level. In Guangdong-Hong Kong-Macao Greater Bay Area, the region where manufacturing enterprises are located is also a regulating variable, and there are different digital atmospheres in different cities or regions. Through the digital platform, enterprises should determine the cost performance of materials and improve the cost management efficiency . Speaking of marketing, warehousing and human resource management of manufacturing enterprises, enterprises should also use the digital management platform to optimize all links, so as to reduce costs and improve efficiency, especially in high-tech manufacturing industry, it is more necessary to assist enterprise management through the digital platform.

Key Problems to Be Addressed

The heterogeneity analysis of collaborative innovation between digital economy and manufacturing industry is the key problem to be addressed. The traditional innovation force does not consider the factor of scale, and unifies the innovation behavior of manufacturing enterprises of different scales. Through the investigation of enterprises in production practice, it is found that innovation behavior between SMEs and manufacturing enterprises above

designated size have huge differences. SMEs have a very low market share, and their innovation behavior is mostly joint imitation, so it is difficult to have new products or technology collaborative innovation. In order to increase the degree of market monopoly, Chinese above-scale manufacturing enterprises will cooperate with new products or technologies. This leads to the heterogeneity of collaborative innovation behavior of manufacturing enterprises. The analysis of heterogeneous innovation behavior needs to be addressed in this project.

This series of studies' focus: explain the driving force of digital economy on manufacturing industry's collaborative innovation mechanism from the endogenous perspective. The way of innovation has always been regarded as a difficult point by the academic community, focusing only on input and output, not on its operating mechanism. The innovation behavior of different enterprises is generally different, which leads to the inaccurate analysis of innovation behavior. The self-organizing synergy theory of this project analyzes the driving path of digital elements from the competitive state to the collaborative innovation state, which is the focus of this project. We need to focus on the effect of digital tools on resource acquisition, resource replacement, cost control and market competition, and then impinge the path mechanism of enterprise collaborative innovation strategy.

Discussion

As the Guangdong-Hong Kong-Macao Greater Bay Area with the largest region and the largest population among the four Bay areas worldwide, Greater Bay Area has many advantages in the digital economy's development. Its digital economy has a large scale, a high degree of industrial technology agglomeration,and outstanding overall innovation ability. However, due to the short period of digital development in the Greater Bay Area, it has significant problems such as the imperfect and asymmetric cross-regional digital business environment, the insufficient supply of digital innovation elements, the unclear willingness of enterprises to digital transformation, and digital value's unclear exploration. different regions'digital development in Greater Bay Area is also obviously unbalanced. Due to the high level of urban development, developed economy , and better digital atmosphere in Shenzhen, Hong Kong ,and Guangzhou(Canton), the digitalization level of the manufacturing industry located in the core areas of these cities is also significantly stronger. However, manufacturing industry's digitalization in some remote areas of Zhaoqing, Jiangmen ,and Huizhou is still relatively backward, and there is a big gap with developed big cities. For regions with strong innovation capacity and technology-intensive industries, local governments can increase investment in digital infrastructure and give full play to the enabling role of digital infrastructure in technology-intensive industries.

In the construction of digital infrastructure, with the popularization of computers and mobile terminals in the manufacturing industry, the construction of network infrastructure has become a priority, including the traditional wired network, mobile communication network and corresponding network services. These infrastructures are more empowering, enabling more industries to integrate with digital technologies. At the same time, in addition to the general infrastructure, there is specific integrated digital infrastructures for different industries, and the construction of this infrastructure is ignored by the current industrial policy and market, which can be strengthened according to the characteristics of the local industry. Although the infrastructure construction level in the core area of the Greater Bay Area has been relatively perfect and the Internet coverage rate is high, there are still some

deficiencies in the construction of new infrastructure, such as the small number of software and information services, the lack of large leading enterprises, and inadequate data statistics. Therefore, the digital business environment's improvement in the Greater Bay area must take digital infrastructure's construction as the core, further optimize the digital innovation and cooperation environment, and realize the coordinated development of the digital industry. It is suggested that the corresponding government should lead to building a regional technology service platform and encourage social capital and technical cooperation, technology transfer ,and diffusion of research institutions, universities ,and enterprises, to enhance manufacturing industry clusters' overall efficiency and international competitiveness. We should focus on strengthening the allotment of funds for the imaginative exploration and integration of fundamental scientific studies, data technology ,and traditional manufacturing industry, implement scientific research projects and horizontal scientific and technological projects in cooperation with well-known universities and research institutions in the region, and guide social capital to tilt towards the innovative research and development of the integration of the digital technology and traditional industries.

The level of innovation has always been the focus of measuring the level of development of the digital economy, and the transformation and upgrading of the manufacturing industry are inseparable from innovation. At the internal level of enterprises, innovation contributes to the optimization and improvement of computer-related technologies, such as the Internet of things, E-commerce, Big Data, Blockchain, Artificial Intelligence ,and other cutting-edge emerging technologies, while addressing data security risks.

According to the experience of recent years, in order to effectively implement the digital economy-driven mechanism of high-quality development of manufacturing industry in the Guangdong-Hong Kong-Macao Greater Bay Area, the first thing to be solved is the top-level design. It is suggested that Guangdong, Hong Kong and Macao take the lead in organizing the participation of experts, scholars, leading enterprises, financial institutions, etc., to select appropriate reform paths according to their own conditions, and formulate a master plan or action plan for digital economy development that meets local realities. The second is to create a good institutional environment. For example, drawing on international experience, we will explore ways to establish a security management system for cross-border data flows, protect intellectual property rights, and maintain fair competition. Third, the digital economy driving mechanism in the Greater Bay Area also includes fostering and expanding the digital economy industry, encouraging the new models of the digital economy' development, attracting investment from overseas digital economy enterprises, and broadening the space for the development of the digital economy. Finally, in the new stage of development, China must unswervingly follow the path of green, low-carbon and circular development. Only with a clear understanding of the bottlenecks restricting the high-quality development of manufacturing in the Guangdong-Hong Kong-Macao Greater Bay Area can we find a more accurate way out.

Collaborative innovation and cutting-edge emerging technologies such as E-commerce, Big Data, Blockchain ,and Artificial Intelligence have had a direct or indirect effect on the manufacturing industry. E-commerce has increased the breadth and depth of manufacturing sales and procurement. Big data helps manufacturers understand market changes more quickly and accurately. The use of artificial intelligence helps the manufacturing industry cut human resources' expenses and raise productivity to a certain extent. These phenomena

indicate that the application of digital technology improves the performance of enterprises to a certain extent.

Information transmission industry, software, and information technology services, their integration with the manufacturing industry makes a positive difference in manufacturing performance. The industrial Internet is a new industry produced by the integration of the information industry and the manufacturing industry, which has strong vitality and huge development potential. Through the industrial Internet, realizing the interconnection of people, machines, things, systems, etc., can enlarge the relevant network of the industrial Internet. At the external level of enterprises, the emergence of technologies such as the Internet and big data can help manufacturing enterprises redefine and integrate customers, and help manufacturing enterprises segment and personalize customer groups. Innovation-driven is the key and difficult point for the manufacturing industry to achieve transformation and upgrading, and it is also the only way. On the one hand, the governments of Guangdong-Hong Kong-Macao Greater Bay Area and cities should continue to rise investment in scientific research funds, promote the collaborative and innovative development , introduce excellent scientific research institutions, and carry out high-tech strategic cooperation with enterprises, so that the scientific research achievements of Colleges and universities can be used by the government and enterprises. On the other hand, enterprises themselves should also continue to increase investment in research and development, set up practical research and development centers, focus on industrial Internet platforms, big data, artificial intelligence, intelligent vehicles, and other enterprises, breakthrough key technologies, and form independent research and innovation achievements. Based on consolidating the manufacturing industry, the government led large enterprises to strengthen technological exploration and progress artificial intelligence's realm , distributed cloud and blockchain, supported the in-depth cooperation between large state-owned enterprises and research institutions in the digital economy and private traditional enterprises, and further tried to build joint research centers, cooperative laboratories and other innovative carriers for digitalization, informatization, and intelligent applications. Promote the construction of digital infrastructure with Cloud Computing, 5G, Blockchain, Big Data, Internet of Things, and Artificial Intelligence as the core, and focus on the implementation of new infrastructure that benefits the business environment of enterprises, such as industrial Internet coverage, speed-up , and fee reduction.

In general, if the digital economy is to promote the collaborative and innovative development of manufacturing in the Greater Bay Area, the original pattern must be broken. Then, local governments need to build an open and sharing platform to further stimulate digital economy's potential and facilitate the manufacturing industry's change. Digital economy's research value on manufacturing industry's high-quality development in the Guangdong-Hong Kong-Macao Greater Bay Area has enriched the literature on the high-quality development of manufacturing industry in the Guangdong-Hong Kong-Macao Greater Bay Area, broadened the research route of the high-quality development of manufacturing industry in the Guangdong-Hong Kong-Macao Greater Bay Area, and optimized the research structure of the high-quality development of manufacturing industry in the Guangdong-Hong Kong-Macao Greater Bay Area.

Conclusion

In future research, more in-depth research methods will be considered. First of all, by analyzing the internal incentive reasons for collaborative innovation in manufacturing enterprises, that is, to control costs and maximize profits. Analyze the internal incentive path of the digital economy to enterprise collaborative innovation. Secondly, analyze the heterogeneity of digital tools on enterprise collaborative innovation behavior, and find the driving differences of different digital tools on enterprise collaborative innovation behavior. Finally, an empirical test, using manufacturing data to verify the mechanism theory and premise assumptions. This paper mainly studies the digital level of the Greater Bay Area and compares and analyzes different regions' digital level, hoping to formulate different digital transformation strategies for different regions. At the same time, some countermeasures and suggestions are put forward according to the analysis results. However, there are also some deficiencies in this paper. For example, due to the unavailability of data, the measurement indicators and data analysis at the digital level is not comprehensive enough, which need to be optimized in future research.

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