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Research on the Development Opportunities and Strategies of Digital Trade in the Guang-dong-Hong Kong-Macao Greater Bay Area under the Background of "Dual Circulation"

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Abstract

Based on the "dual circulation" strategic framework, this study constructs a three-dimensional collaborative theoretical model of "system - industry - tech-nology" and proposes differentiated development strategies. Research findings show that the Greater Bay Area, relying on the institutional advantages of "one country, two systems, and three customs territories", has formed distinctive advantages such as cross-border e-commerce, digital infrastructure, and a closed loop of the innovation chain. However, issues such as data standard barriers, core technologies being controlled by others, and the lagging transformation of small and medium-sized enterprises in the three regions still restrict its devel-opment. The international competitiveness of digital trade in the Greater Bay Area can be effectively enhanced through institutional measures.

Keywords

The dual circulation strategy; The Guangdong-Hong Kong-Macao Greater Bay Area; Digital trade

1. Introduction

Against the backdrop of the accelerated digital transformation of the global economy and the interweaving of the century-old changes, China has proposed to build a new development pattern with domestic circulation as the mainstay and domestic and international circulations reinforcing each other (the "dual circula-tion" strategy). The report of the 20th National Congress of the Communist Party of China clearly incorporates digital trade into the core strategy of "accelerating the building of a trade power", emphasizing "innovating the development mecha-nism of service trade "Develop digital trade." As a strategic support point of the country, the Guangdong-Hong Kong-Macao Greater Bay Area, with the largest scale of digital economy in the country (the digital trade import and export vol-ume reached 82.1

billion US dollars in 2022, accounting for 51.75% of the prov-ince's service trade), active cross-border financial innovation (Hong Kong ranks 9th in the global fintech ecosystem), and the institutional advantages of "one country, two systems", It has been entrusted with the mission of building a leading area for global trade digitalization. Policies such as the "Plan for the Construction of the Hengqin-Macao In-depth Cooperation Zone" and the "Plan for Comprehen-sively Deepening the Reform and Opening-up of the Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone" explicitly state that "we should pro-mote the connection of rules and mechanisms and build a high-level gateway hub for opening up to the outside world", and require the Greater Bay Area to take the lead in piloting in areas such as digital trade rule innovation and cross-border data flow. Meanwhile, the "14th Five-Year Plan for the Development of the Digital Economy" emphasizes "accelerating the digital development of trade and pro-moting the in-depth development of the 'Digital Silk Road'", providing an action guideline for the integration of digital trade in the Greater Bay Area into the global value chain reconstruction. However, the Greater Bay Area still faces challenges such as data standard barriers among the three regions and the lagging digital transformation of small and medium-sized enterprises. Issues like high compli-ance costs for cross-border data flows and insufficient international competitive-ness of digital service export bases need to be urgently addressed. Against this backdrop, exploring the opportunities and strategies for digital trade in the Guangdong-Hong Kong-Macao Greater Bay Area under the "dual circulation" mod-el is not only an inevitable requirement for implementing national strategies but also a key path to promoting high-quality regional economic development and enhancing international competitiveness.

2. The current situation of digital trade development in the Guangdong-Hong Kong-Macao Greater Bay Area

2.1. Institutional opening-up and innovation driven by policies

Through institutional innovation under the framework of the "dual circulation" strategy, the Guangdong-Hong Kong-Macao Greater Bay Area has established a digital trade system of "three zones and three platforms" (the three free trade zones of Hengqin, Qianhai and Nansha and the CEPA, RCEP and international dig-ital trade rule alignment platforms). The "Action Plan for Promoting High-Quality Development of Service Trade in Guangdong Province (2021-2025)" clearly de-fines digital trade as the core growth pole and promotes institutional opening up through the "Six Connections and One Integration" project (trade entities, full chain, new business forms, service trade, digital public system, and governance system innovation). Data shows that in 2022, the import and export volume of digital services in the Greater Bay Area reached 82.05 billion US dollars, account-ing for 20% of the national total. Among them, the import and export volume of cross-border e-commerce has ranked first in the country for five consecutive years, reaching 331

billion yuan in 2023, forming a dual-core driving pattern of "Qianhai Cross-border E-commerce Comprehensive Pilot Zone + Hengqin Digital Trade International Hub Port".

2.2. Infrastructure Reconstruction Empowered by Technology

The digital infrastructure in the Greater Bay Area features "three surpasses" : the density of 5G base stations is over three times that of the national average (280,000), industrial Internet identification resolution nodes cover more than 40 industries, and the scale of computing power infrastructure exceeds 1.2 million standard racks. Through the construction of the "Digital Bay Area", an integrated infrastructure system of "cloud, network and terminal" has been established: the Greater Bay Area Data Exchange has been deployed in the cloud, achieving a data element circulation scale of over 3 billion yuan. The network layer has established a dedicated channel for international Internet data, with a latency of less than 20ms. The terminal layer has formed an intelligent annotation industrial cluster, with the scale of language data annotation reaching 4.402 billion yuan and the number of patent applications ranking second in the country. The "5G+ Industrial Internet" application scenarios led by leading enterprises such as Huawei and Tencent have increased the efficiency of digital transformation in the manufac-turing industry by 40%.

2.3. Ecological development model of industrial collaboration

Form a closed loop of the innovation chain of "basic research (Hong Kong) - technology development (Shenzhen) - technology transfer (Dongguan) - scenario application (Macao)". In the field of cross-border e-commerce, Qianhai in Shen-zhen has achieved "buying globally and selling globally" by relying on the global central warehouse model, with its import and export volume exceeding 100 billion yuan in 2023. In terms of digital service exports, the Tianhe Central Business Dis-trict has gathered 100 leading enterprises, and the digital service export base con-tributes 60% of the province's digital trade volume. It is worth noting that the dig-italization rate of traditional service trade has reached 58%, among which profes-sional services such as law and construction have achieved cross-border pro-cessing through digital government platforms, and the rate of "one-stop online processing" for business registration has reached 92%.

3. Opportunities for Digital Trade development in the Guang-dong-Hong Kong-Macao Greater Bay Area

3.1. Strategic Opportunities of Institutional Opening-up: Rule Alignment and Governance Innovation

1)Superimposed empowerment from national-level policies

The Greater Bay Area has been incorporated into the national strategic framework of the "Trade Digitalization Leading Zone". Relying on policies such as the

"Con-struction Plan for the Hengqin-Macao In-depth Cooperation Zone" and the "Plan for Comprehensively Deepening the Reform and Opening-up of the Qianhai Shen-zhen-Hong Kong Modern Service Industry Cooperation Zone", a "three zones and three platforms" institutional system has been established (the Hengqin, Qianhai, and Nansha Free Trade zones and the CEPA, RCEP, and international digital trade rules alignment platform). Promote institutional opening-up through the "Six Connections and One Integration" project (trade entities, full chain, new business forms, service trade, digital public system, and governance system innovation). Data from 2025 shows that the digital service import and export volume of the Greater Bay Area accounts for 20% of the national total. The cross-border e-commerce import and export volume has ranked first in the country for five consecutive years, forming a dual-core-driven pattern of "Qianhai Cross-border E-commerce Comprehensive Pilot Zone + Hengqin Digital Trade International Hub Port".

2)The CEPA framework deepens the liberalization of trade in services

Under the framework of CEPA, Guangdong has implemented the shortest negative list in the country for Hong Kong and Macao (only 70 items), achieving full open-ing up in professional service fields such as law and architecture. In 2023, the lib-eralization rate of trade in services in the Greater Bay Area reached 92%, and the import and export volume of digital services accounted for 20% of the national total. Through the digital government platform, business registration for enter-prises from Hong Kong and Macao can be handled online. In the past three years, 50,000 new enterprises funded by Hong Kong and Macao have been introduced, and 340 billion yuan of funds from Hong Kong and Macao have been actually uti-lized.

3.2. Reconstruction of Digital Infrastructure: New Infrastructure Clus-ters and Data Element Circulation

1)The "three superpowers" characteristics of digital infrastructure

The Greater Bay Area has built 280,000 5G base stations (with a density three times that of the national average), and the latency of dedicated international In-ternet data channels is less than 20ms. The scale of computing power infrastruc-ture clusters such as Peng Cheng Laboratory exceeds 1.2 million standard racks. The digital supervision model of Hengqin's "Smart Customs" has increased the customs clearance efficiency by 40%. The cumulative transaction volume of the Guangzhou Data Exchange has exceeded 3 billion yuan. It is exploring the "Data Customs" supervision model and promoting the "South Data Northward, North Data Southward" plan. The goal is to build a unified data element market in the Greater Bay Area by 2025.

2)Breakthroughs in the marketization of data elements

Through the construction of a "Trusted digital space", cross-border data security circulation and trading can be achieved, empowering the leap of digital technolo-gies such as artificial intelligence. In 2024, there will be 120 pilot projects for cross-border data flow in the Greater Bay Area, covering fields such as finance and

healthcare. The cost of data element circulation will be reduced by 22% compared with that in the Yangtze River Delta.

3.3. Industrial Collaborative Innovation: Global Value Chain Recon-struction and Ecological Development

1) Construction of a global digital trade hub

A "cross-border e-commerce + industrial belt" integration model has been formed. The Qianhai Global Center Warehouse model in Shenzhen has achieved an annual import and export volume of over 100 billion yuan, and the digital manufacturing base in Dongguan supports 70% of the cross-border e-commerce exports in the Pearl River Delta. In 2023, the global digital services trade volume reached 6.5 trillion US dollars. The Greater Bay Area, leveraging its cluster advantage in the digital industry chain, holds a 12% market share. The digitalization rate of tradi-tional service trade has reached 58%, and professional services such as law and construction are handled cross-border through digital government platforms.

2) Expansion of the digital service export base

The Tianhe Central Business District has gathered 100 leading digital trade enter-prises and cultivated internationally competitive companies such as NetEase and 37 Interactive Entertainment. In 2024, Guangzhou's service trade imports and exports exceeded 75 billion US dollars, with digital services accounting for 40%, forming six distinctive export fields including digital content and digital finance. The Shenzhen Cross-border Trade Big Data Platform has increased the efficiency of supply chain finance by 40%.

3.4. Regional Coordinated Development: International Channels and Financial Innovation Empowerment

1)The construction of digital channels for the Belt and Road Initiative

The Greater Bay Area has established digital economy cooperation zones with 15 countries along the routes. Through digital government platforms, it enables one-stop online business registration for Hong Kong and Macao. In 2023, it has driven the actual utilization of foreign capital in the digital economy sector to ex-ceed 50 billion yuan. The Hengqin China-Portugal International Trade Center has facilitated an average annual growth rate of 28% in digital service trade between Portuguese-speaking countries, forming a model of "research and development in Macao + transformation in Hengqin".

2) Cross-border Financial Innovation and Digital Currency Application

The business scale of "Cross-border Wealth Management Connect" has exceeded 300 billion yuan, and the blockchain trade finance platform has achieved over 100 billion yuan in accounts receivable financing in the Greater Bay Area. As an in-ternational financial center, Hong Kong provides cross-border settlement, digital currency and other financial services for digital enterprises in the Greater Bay Area.

By 2024, the penetration rate of digital payment is expected to reach 85%. The Greater Bay Area Digital Currency Research Institute, in collaboration with the Hong Kong Monetary Authority, has launched a pilot program for cross-border digital RMB payments.

3.5. Technical Standard Leadership: International Rule Output and In-novation Source

1)Construction of a digital technology standard system

The Greater Bay Area takes the lead in formulating the world's first international standard for data asset management (ISO55013) and recommended standards for Internet arbitration. In 2025, it plans to release 10 international standards in-cluding those on artificial intelligence ethics and digital identity authentication. In 2024, 110 standards for the Bay Area will be released, covering fields such as food, Cantonese cuisine, and traditional Chinese medicine, promoting the patent-ing of technologies, the standardization of patents, and the industrialization of standards.

2) Research and industrialization of cutting-edge technologies

Pengcheng Laboratory has obtained 23 core patents in the field of 6G communi-ca-tion. Sensetime has established a global R&D headquarters in the Greater Bay Area, driving the commercial application of digital technologies such as AI visual in-spection and intelligent logistics. It is expected that the export value of digital technology will exceed 50 billion US dollars in 2025, forming a closed loop of the innovation chain of "basic research (Hong Kong) - technology development (Shen-zhen) - technology transfer (Dongguan) - scene application (Macao)".

4. Theoretical Framework and Strategic Combinations for the Development of Digital Trade in the Guangdong-Hong Kong-Macao Greater Bay Area under the Coupling of Dual Circu-lation

4.1. Institutional Innovation: Build a new model for cross-border digi-tal governance and break through the institutional barriers of "one coun-try, two systems, and three customs territories"

Institutional innovation is the core engine for digital trade in the Guang-dong-Hong Kong-Macao Greater Bay Area to break through "institutional barriers". Its essence lies in transforming the institutional advantages of "one country, two systems" into competitive advantages in digital trade through the connection of rules and the re-construction of the governance system. In the field of cross-border data flow, the Greater Bay Area is piloting a "data customs" regulatory model. It has established "data classification and grading standards" in six major fields in-cluding biomedicine and finance on platforms such as Hengqin and Qianhai, achieving cross-border cir-culation of scientific research data that is "usable but not visible". For instance, sci-entific research data from universities in Hong Kong can be shared with mainland

enterprises through a secure sandbox, thus safe-guarding data sovereignty. It also activates the flow of innovative elements. By 2025, this model is expected to reduce the cost of data element circulation in the Greater Bay Area by 25% compared to the Yangtze River Delta, and compress the compliance time for cross-border data flow from 7 days to 24 hours.

In terms of mutual recognition of digital service rules, the Greater Bay Area has raised the coverage rate of mutual recognition of electronic signatures from 65% to 90% and established a mutual recognition mechanism for "Bay Area Digital Certificates". Take the legal services industry as an example. Through the "Qianhai Pilot", lawyers from Hong Kong and Macao can directly provide non-litigation le-gal services on the Chinese mainland. In 2023, over 2,000 new cross-border prac-ticing lawyers were added, driving a 40% increase in digital revenue for the legal services industry. Meanwhile, under the CEPA framework, the Greater Bay Area has included emerging business forms such as digital advertising and online edu-cation in the negative list management, reducing the number of items from 120 to less than 50, achieving a high-level opening up of "no prohibition, no entry".

Collaborative protection of intellectual property rights serves as the "ballast stone" for innovation in digital trade. The Greater Bay Area has established a "one country, two systems" intellectual property trading center. Hong Kong patents can be confirmed in the mainland through a "fast track", and the approval period has been shortened from 18 months to 3 months. In response to the issue of digital content infringement, a pilot model of "copyright blockchain evidence storage + judicial chain verification" has been piloted, reducing the infringement handling cycle from six months to 20 days. By 2024, it has already helped digital content enterprises recover losses of over 1 billion yuan. These institutional innovations not only reduced transaction costs but also established a digital trade governance system in line with international standards.

In the reconstruction of the governance system, the collaborative governance framework of digital government is a key support. The "One-Stop Online Service" platform for government affairs in the Greater Bay Area has integrated 127 ser-vices. Matters such as business registration and tax declaration for enterprises from Hong Kong and Macao can now be handled within the Greater Bay Area. By 2024, it is expected to handle over 5 million business transactions in total. The Cross-Regional Digital Supervision Joint Laboratory, by applying federated learn-ing technology, has achieved risk information sharing while protecting data pri-vacy. In 2023, it successfully warned of over 200 cases of false transactions in cross-border e-commerce. In addition, the cross-border digital taxation coordina-tion mechanism is piloting a dual tax calculation standard of "user participation + data value" in the Nansha Free Trade Zone, exploring cross-border settlement with digital currencies. It is expected that by 2025, the proportion of digital currencies in cross-border payments in the Greater Bay Area will exceed 30%, significantly enhancing the efficiency of capital

flow. The risk prevention and control system monitors risks such as data leakage and cyber attacks in real time through the "Digital Trade Risk Radar System", and implements inclusive and prudent man-agement of new business forms in combination with "sandbox supervision", which not only prevents systemic risks but also leaves sufficient space for innovation.

4.2. Industrial Synergy: Building a new highland of the global digital value chain and reconstructing the industrial ecosystem of the "dual circulation"

Industrial collaboration is the core carrier for creating value in digital trade. Re-lying on the innovation chain of "basic research (Hong Kong) - technology devel-opment (Shenzhen) - technology transfer (Dongguan) - scene application (Ma-cao)", the Greater Bay Area has built a closed loop of cross-border digital industri-al chains. In the collaborative model of "Guangzhou-Shenzhen-Hong Kong R&D + Manufacturing on the West Bank of the Pearl River", the Shenzhen-Hong Kong Science and Technology Innovation Cooperation Zone has become a digital tech-nology R&D center, focusing on breaking through "bottleneck" technologies such as quantum communication and edge computing. By 2024, it had already incubat-ed 10 unicorn enterprises. As a global digital manufacturing base, Dongguan takes on 70% of Shenzhen's smart hardware contract manufacturing orders, forming a "one-hour industrial collaboration circle". In 2023, its digital manufacturing out-put value exceeded 800 billion yuan, supporting 70% of cross-border e-commerce exports in the Pearl River Delta.

The construction of digital service export bases is a key approach for climbing the value chain. The Tianhe Central Business District has gathered 100 leading digital trade enterprises, covering six distinctive fields including digital content and dig-ital finance. In 2024, the import and export of service trade will exceed 75 billion US dollars, with digital services accounting for 40%. The "Global Central Ware-house" model in Qianhai, Shenzhen, has achieved an annual import and export volume of over 150 billion yuan through "buying globally and selling globally". The "Market Procurement + Cross-border E-commerce" integration pilot zone in Dongguan has reduced the customs clearance time for a single ticket to 15 minutes, driving a 35% increase in the exports of small, medium and micro enterprises in 2023. These practices demonstrate that industrial collaboration is not merely a simple integration of resources, but rather a value-added closed loop of "R&D - manufacturing - service" formed through vertical integration of the industrial chain and cross-regional division of labor.

The output of digital technology standards is a core symbol of the upgrading of the value chain. The Greater Bay Area takes the lead in formulating the world's first international standard for data asset management (ISO55013), and has pushed 10 international standards including AI ethics and digital identity authentication in-to the research and development stage. It is expected that the first batch of 5 standards

will be released in 2025, facilitating the "going global" of Chinese rules. Meanwhile, through the digital government platform, one-stop online business registration for Hong Kong and Macao will be realized, driving the export of pro-fessional services such as law and construction. By 2025, the digitalization rate of professional services is expected to reach 75%, forming a new business form of "digital + professional services". The digital transformation of small and medi-um-sized enterprises (smes) serves as the "capillaries" of industrial collaboration. The Greater Bay Area has established a public service platform for digital trans-formation, providing low-cost modular intelligent equipment. By 2025, the digi-talization rate of large-scale industrial enterprises will exceed 80%, and that of smes will break through 50%, completely resolving the issue of the "digital divide among large, medium and small enterprises".

4.3. Technology Empowerment: Build an independent and controllable technology system to consolidate the underlying support for digital trade

Technology empowerment is the underlying logic of the development of digital trade. The Greater Bay Area has created a virtuous cycle of "technology - data - application" through the construction of digital infrastructure clusters and core technology research and development. In the field of digital infrastructure, the Greater Bay Area has built 320,000 5G base stations (with a density 3.5 times that of the national average), and the latency of the dedicated international Internet data channel is less than 18ms. The computing power scale of the Peng Cheng La-boratory has exceeded 1.5 million standard racks, supporting the training needs of large AI models. The cumulative transaction volume of the Guangzhou Data Ex-change has exceeded 5 billion yuan. It is exploring a trading model of "data availa-ble but not visible". By 2025, a unified market for data elements in the Greater Bay Area will be established, achieving data intercommunication with regions such as Singapore and the European Union. The intelligent annotation industry cluster focuses on language data processing, forming a scale of 4.402 billion yuan. The development of multi-modal intelligent annotation tools has increased efficiency by 60%, and the shortage of high-end annotation talents has been reduced to 500,000, providing "data fuel" for the digital content industry.

Core technology breakthroughs serve as the "hardcore" support for technological empowerment. In the field of 6G communication, Peng Cheng Laboratory has laid out 23 core patents. Sensetime has established a global R&D headquarters to drive the commercialization of AI visual inspection technology. It is expected that the export value of digital technology will exceed 60 billion US dollars by 2025. The construction of an open-source ecosystem reduces the cost of technology acquisi-tion by 40%, attracts 30% of global AI developers to participate, and forms an in-novation chain of "basic research (Hong Kong) - open-source development (Shenzhen) - commercial application (Dongguan)". Digital twin technology has been

applied in Hengqin to build a digital trade twin platform between China and Portugal, achieving full life cycle visualization of goods. The penetration rate of digital twins in the manufacturing industry has reached 35%, and the product re-search and development cycle has been shortened by 30%. These technological breakthroughs have not only enhanced the digital trade competitiveness of the Greater Bay Area, but also enabled it to participate in global rule-making through the export of technical standards, achieving a leap from "technology following" to "rule leading".

4.4. Strategy Combination and Implementation Path: Systematic Ad-vancement under Three-Dimensional Synergy

To ensure the implementation of the theoretical framework, it is necessary to construct a strategic combination of "institutional innovation breakthrough Ac-tion - Industrial collaborative upgrading Project - Technology empowerment Breakthrough Action". In the field of institutional innovation, the "Regulations on Promoting Digital Trade in the Guangdong-Hong Kong-Macao Greater Bay Area" will be formulated from 2025 to 2027, and a dynamic adjustment mechanism for the "white list" of cross-border data flows will be established. Under the CEPA framework, 20 new digital service opening provisions have been added to promote mutual recognition of digital payment and electronic certification rules. Build three national-level digital trade rule pilot zones and conduct pressure tests on cross-border data flows. The guarantee mechanism includes the establishment of the Greater Bay Area Digital Trade Development Committee for overall coordina-tion, the setting up of a 10 billion yuan innovation fund to support key technology research and development, and the implementation of the "Digital Trade Compli-ance Officer" training program (with an annual training of 5,000 people).

The industrial synergy and upgrading project focuses on the construction of the "4+6" digital industrial clusters (4 core industries +6 supporting industries) and 10 cross-border digital industrial parks, promoting the full-chain synergy of "Hong Kong R&D and design - Shenzhen prototype development - Dongguan intelligent manufacturing - Macao scene application". The "Digital Brand Going Global Pro-gram" was implemented to cultivate 50 international brands. A digital service ex-port alliance was established to promote an average annual growth rate of 25% in professional service export value. The "Spark Program" for the digital transfor-mation of small and medium-sized enterprises was launched, covering 100,000 small and medium-sized enterprises.

The Technology Empowerment breakthrough action focuses on the breakthrough of digital infrastructure and core technologies. By 2025, an international Internet data dedicated channel (with a latency of less than 15ms) will be built, 5,000 edge computing nodes will be deployed to support real-time response of the industrial Internet, and a digital twin city in the Greater Bay Area will be constructed to en-hance

management efficiency by 40%. In terms of breakthroughs in core technol-ogies, the "Strong Core and Soul Casting" project was implemented to increase the self-sufficiency rate of high-end chips to 25%. Key technologies for quantum communication were broken through to build the Guangzhou-Foshan-Zhaoyang trunk line. An independently controllable AI framework was developed to enter the top five of the global open-source community.

5. Conclusion

The "dual circulation" development of digital trade in the Guangdong-Hong Kong-Macao Greater Bay Area essentially involves breaking down barriers through institutional innovation, reconstructing value through industrial collab-oration, and consolidating the foundation through technological empowerment, ultimately forming a new development model of three-dimensional collaboration among "institutions - industries - technologies". This model not only provides path guidance for the Greater Bay Area to build a global digital trade leading zone, but also contributes a Chinese solution to digital cooperation under the Belt and Road Initiative and global digital economy governance through replicable institu-tional opening-up experiences. In the future, with the implementation of various strategies, the Greater Bay Area is expected to become a major rule-maker for global digital trade and a core hub for value creation.

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