

## RESEARCH ARTICLE

# Exploration of Digital Transformation of Government Governance Under the Information Environment

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**ABSTRACT** Guangdong-Hong Kong-Macao Greater Bay Area’s (GBA) digital government construction is one of the most important national strategic plans made by China, which constitutes an important support point for the construction of “the belt and road initiative”, and is of great significance for promoting the position and function of Hong Kong and Macao in national economic development and opening to the outside world. As far as the construction of digital government is concerned, it is also affected by the multi-dimensional infiltration of the environment of the times. It is urgent to discuss “the deep-seated internal cause of the new environment created by the digital era driving the construction of digital government” from a more macroscopic perspective. This paper studies the construction of digital government in GBA through the digital transformation of government governance in the information-based ecological environment. The information-based ecological environment is a process of collecting, managing, developing and utilizing data resources, promoting the deep integration of information technology and ecological environment business, and constantly improving the modernization level of ecological environment governance system and governance capacity. In order to better integrate Internet thinking with the innovation of government governance tools, coordinate and promote the development of digital economy (DE) and smart society, it is necessary to explore the effective combination of digital development law and government governance mode in the information ecological environment.

**INDEX TERMS** Informatization ecological environment, digital transformation of government governance, digital government construction.

## I. INTRODUCTION

The modernization of the national administration system and administration capacity is the “fifth modernization” led by the Communist Party of China after the modernization of agriculture, industry, national defense, and science and technology. One belt, one road, is the most important

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strategic plan for China. It constitutes an important support point for the construction of the “one belt and one road”. It can effectively improve its position in the national economic development and opening to the outside world [1]. Compared with the gradual and one-dimensional reform strategy implemented in the past, the modernization of the national administration system and administration capacity emphasizes that in the new stage of comprehensively deepening reform, we should “pay more attention to the

systematicness, integrity, and synergy of reform”, and highlight the comprehensiveness, compatibility, and sustainability of comprehensively deepening reform with the theme of “national administration” [2]. Guangdong is at the forefront of opening to the outside world and has good conditions for the construction of GBA. Adjacent to Hong Kong and Macao, Guangdong has the unique location advantage of GBA; Guangdong is a pioneer in reform and innovation and has the basic quality of Dawan district construction. Worldwide, the bay area is not only a geographical concept but also an economic phenomenon [3]. The formation of the bay area is a special economic form resulting from the evolution of industrial civilization to scientific and technological civilization and land culture to marine culture. It plays a strong role in promoting the industrial upgrading and economic development of the urban agglomeration around the Bay and thus becomes an important growth pole of the global economy. There is no doubt that Guangdong is not only a participant but also a major undertaker and also a leader in the construction of GBA [4]. This is not only the basic requirement for the work of the whole province but also the basic positioning of the due role of Guangdong governments at all levels in the construction of digital government in GBA.

The modernization of government governance is the key link and important symbol of the modernization of state governance. Therefore, this paper studies the exploration and innovation of digital transformation of government governance under the information environment. Under the guidance of the national information development policy, following the reform of ecological environment management system, through the implementation of a number of major projects, the ecological environment informatization has developed steadily, which has gone through four stages: initial exploration, expanded application, scale construction and unified concentration. The infrastructure of Shanghai’s digital transformation of manufacturing industry is in a leading position in China, which provides a solid infrastructure support for the digital transformation of manufacturing industry [5]. The Fourth Plenary Session of the 19th Central Committee of CPC pointed out: “We should use the Internet, big data, artificial intelligence and other technical means to establish and improve administrative rules [6], [7]. Digital government construction is an important content of “Building Digital China” put forward by the 19th National Congress of the Communist Party of China, and it is an urgent requirement to accelerate the modernization of government governance under the new development concept and new development pattern. Governance reform activities are complex and influenced by many factors, rather than being driven by a single factor [8]. As far as the construction of digital government is concerned, it is also influenced by the multi-dimensional infiltration of the environment of the times. It is urgent to discuss “the deep-seated internal cause that the new environment created by the digital era drives the construction of digital government” from a more macroscopic perspective [9], [10]. From the viewpoint of the overall ecological connection and balanced interaction

of the information-based ecological environment, all the complex systems, elements and related phenomena related to the city’s resources, environment, population, economy, etc. should be digitally reproduced and recognized, a shareable database should be established, and relying on the network, a highly information-based ecological city with regional characteristics that can coexist with nature should be built, so as to realize the city ideal of sustainable development of the information-based ecological environment.

Powerful and novel digital and intelligent technologies will provide an indispensable scientific and technological impetus for the modernization of the governance system and capacity [11], [12]. The information-based ecological environment is a transformation from the traditional economic development mode to the compound ecological development mode, which takes into account the sustainable development of population, society, economy and environment. The information-based ecological environment pays attention to the development and transformation of the overall ecological benefits, so as to realize the overall coordination of the natural-economic-social compound ecological system of the urban information-based ecological environment and achieve a stable and orderly evolution. The accelerated iterative improvement of the Internet and applications, as well as the popularization of mobile smart technologies such as mobile phones, not only promote the continuous optimization of the information technology environment, but also further highlight the core and key position of data, and accelerate the digital transformation of traditional government governance ideas and models [13]. The rapid development and wide use of digital and intelligent technologies have improved the efficiency of production, operation, management, logistics and other links in all walks of life, promoted the transformation of economic growth mode, and effectively reduced the development cost [14], [15]. As a new way of national governance, digital government is facing unprecedented historic opportunities and is at the key development node. It is necessary to take the development of information civilization in the information-based big ecological environment into the view of ecological cycle, starting from the ecological holistic view, the balanced view and the dynamic view, so as to standardize and coordinate the relationship between information and various elements in the city and within the information system, improve the quality and benefit of the information-based big ecological environment, and enhance the development potential of information.

## II. RELATED WORK

Literature [16] points out that GBA is the highest degree of DE development in China. Literature [17] Through the method of big data analysis, GBA is a national strategic top-level design for the coordinated development of GBA under the framework of “one country, two systems”. The difference of “9 +2” urban development means that GBA is facing realistic barriers different from the development of mature bay areas in the world. Literature [18] Research shows that accelerating digital industrialization and industry

digitalization, promoting the deep integration of the DE and the real economy, building an internationally competitive digital industrial cluster, and creating a new highland of global DE development has become the development direction of high-quality construction of GBA. Literature [19] suggests that GBA is the largest and most populous bay area in the world at present, and it is also an urban agglomeration with the highest economic correlation with countries along the Maritime Silk Road. Literature [20] At the same time, technological development has provided conditions for the reform of government institutions, the government organizational structure is developing towards a more flat and decentralized direction, the mechanism is more flexible, and a service-oriented government providing services on demand is gradually formed. Literature [21] shows that studying these realistic barriers from the institutional level is conducive to promoting the seamless connection of factor resources within the Bay Area and the openness of the Bay Area economy, and giving full play to the unique advantages and functions of GBA in the national development strategy. Literature [22] proposes that technological change reshapes the social structure and brings new opportunities and challenges to government administration. Taking advantage of its advantages and avoiding its disadvantages, we can use the power of science and technology to promote the reform of government administration structure, process and mode. Literature [23] through the big data analysis method, GBA is a new alliance development model to promote the deep integration of the Pearl River Delta urban agglomeration. Through the upgrading and transformation of traditional industries, the Pearl River Delta urban agglomeration is developed into a world-class Dawan District driven by high-end manufacturing and a modern service industry. Literature [24] studies show that the industry digitization part is based on the corresponding relationship between the input and output of the information and communication technology industry to each industry in the input-output table, which calculates the output pulling effect of the information and communication technology industry on other industries, and then measures the integration part of the DE in traditional industries. Literature [25] puts forward that the modernization of administration capacity calls for the modernization of administration tools and administration models. Building a digital government can walk out of a new way of deep integration of technological innovation and government administration innovation in the process of practicing the new development concept [26].

This paper explores and innovates the digital government construction in GBA through the digital transformation of government governance under the information ecological environment. The development of digital and intelligent technology has changed the government's ability to collect and analyze information, and promoted the business process reengineering and resource integration optimization. The information ecological environment provides the foundation for realizing cross-departmental and cross-level business collaboration and accurate service. As the main trend of

urban development, ecology and informatization represent an advanced and high-level evolution mode, and they are organically integrated objectively, that is, informatization is an important supporting force and the only way for urban ecologization, and ecologization is the first principle and fundamental goal of urban informatization. Whether it is the integration of other environmental factors except technical factors or the multi-dimensional perspective of digital government construction, there is still a broad research space.

### III. DIGITAL ADMINISTRATION: TECHNOLOGY OPTIMIZATION ADMINISTRATION

#### A. GOVERNMENT GOVERNANCE IN THE INFORMATION ENVIRONMENT

In the tide of economic globalization, digital governance is still in the stage of vigorous development. Combining with the actual national conditions of Chinese society, when implementing digital transformation, the government should not only prevent the conflict of new public management, but also avoid the obstruction of narrow view of technology application. How to creatively exert the potential advantages of digital transformation is a key issue for local governments to consider when implementing reform. The information-based ecological environment refers to the process of collecting, managing, developing and utilizing data resources for the decision-making, management and service of ecological environment, promoting the deep integration of information technology and ecological environment business, and constantly improving the modernization level of ecological environment governance system and governance capacity. At the same time, the technological development of information-based ecological environment has provided conditions for the reform of government institutions. The government organizational structure is developing in a more flat and decentralized direction, the mechanism is more flexible, and a service-oriented government that provides services on demand is gradually formed. At present, the construction of digital government has become the new focus of competition among governments of various countries, and the future smart government is the general trend, and the construction of digital government is becoming a trend. The information-based ecological environment is an organic component of national network security and information construction, an important content and support of ecological environment protection, and directly relates to the ability of ecological environment departments to perform their duties. The inefficient information transmission mode can be changed by technological and institutional innovation of information environment, the government's business model and service model can be reshaped, the administrative examination and approval process can be optimized, the supervision and management can be strengthened, the service quality can be improved, and the government's governance ability can be improved, so as to stimulate the market vitality and social innovation to the maximum extent and promote the high-quality development of the social economy. The

architecture diagram of government information resource sharing and exchange platform is shown in Figure 1.

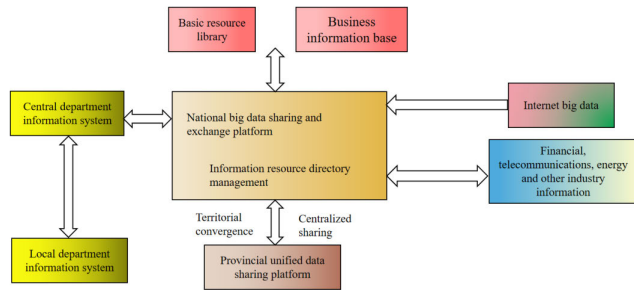


FIGURE 1. Government information resources sharing and exchange platform.

The num of neurons in that hidden lay can be determined by three empirical formulas.

$$k < \sum_{i=0}^n \binom{m}{i} \quad (1)$$

where k is the number of training samples, n is the number of input neurons, n1 is the number of hidden neurons, and when  $I > n1, \binom{m}{i} = 0$

$$n_1 = \sqrt{n - m + a} \quad (2)$$

where m is the number of output neurons, n is the number of input neurons, a is between 1 and 10, and n1 is the number of hidden neurons.

$$n_1 = \log_2 n \quad (3)$$

where n is the number of input neurons and n1 is the number of hidden layer neurons.

The selection of training data is related to the accuracy of neural network. Root mean square error is often used to quantitatively reflect the learning performance. The root mean square error function is defined as follows

$$e = \sqrt{\frac{\sum_{i=1}^m \sum_{j=1}^n (d_{ij} - y_{ij})}{m \cdot n}} \quad (4)$$

where m represents the number of samples in the training set, and n is the number of output units of the neural network.

The cost function is a function that describes the relationship between the amount of training data and the error. Rewrite the error function to

$$e = \sqrt{\frac{\sum_{i=1}^m \sum_{j=1}^n (d_{ij} - y_{ij})}{Xm \cdot n}} \quad (5)$$

When an independent variable x is added in the formula, when  $X = 1$ , the function is the original form. The form of the cost function is

$$y = x / \left(1 - \frac{1}{\sqrt{x}}\right) \quad (6)$$

The degree of interdependence between the two attribute sets B and  $R \subseteq U$  It can be measured by attribute dependency function. As defined below

$$y_R(B) = \frac{card(POS_R(B))}{card(U)} \quad (7)$$

$$POS_R(B) = \bigcup_{X \in U / IND(B)} \quad (8)$$

In the above formula,  $card(\cdot)$  is the cardinality of the set and  $posr(b)$  is the positive region of attribute set R in  $U / ind(b)$ .

The narrow view of application of technology is a common phenomenon in digital transformation, and the government will be highly dependent on the application of technology. When building a “bridge” between the government and the public, it should not fall into the technical misunderstanding. It is believed that with the application of digital technology, all government affairs problems can be solved, and the marginal thinking of technical assistance theory in the traditional concept should also be avoided. Informatization is characterized by electronization, intelligence, globalization, non-grouping, comprehensiveness, competitiveness, permeability and openness. Eco-environmental informatization is a process of continuous development and evolution. In the process of construction, it is different from other industries’ informatization, and has the characteristics of great difficulty in business, numerous types of objects, wide coverage and many participants. “To speed up the construction of digital China is to adapt to the new historical orientation of China’s development, comprehensively implement the new development concept, cultivate new kinetic energy with informatization, promote new development with new kinetic energy, and create new glory with new development.” The leading change of logic is the first premise to explore the potential of transformation in a pioneering way. Facing such a reform, receptive learning will always bring some unexpected results compared with exclusive acceptance. For government departments and public officials, this not only ensures the smooth development of the transformation, but also prevents a big shock in the process. Cancelling and reshaping policy measures is the driving force that fully takes into account the “intelligent” upgrade and performance value, rather than too simple termination. Informatization construction faces all business fields of ecological environment. Eco-environmental business has the characteristics of strong professionalism and complicated process. Related businesses are divided by region, including international, national, regional, river basin, sea area, etc. According to the elements, including atmosphere, water, soil, ecology, ocean, climate, nuclear and radiation, solid waste, hazardous waste, chemicals, noise, pollution sources, etc. According to the management methods, including EIA, monitoring, supervision, supervision, law enforcement, emergency response, etc. It can be seen that the digital and intelligent development in various fields of society is an important driving force for industrialization and urbanization. The development and application of new generation information technologies such as cloud computing, big data and blockchain have promoted

the adjustment of government functions and the extension of governance content, providing a new opportunity for promoting the transformation of digital government.

It promotes the transformation of economic growth mode to innovation and intensification, promotes the development of emerging industries and the full sharing of social information, changes and reshapes China’s economic, social and cultural foundation, and drives the government to focus on the people, optimize services, and quickly transform its administration mode to meet the development needs of the digital and intelligent era. Forward looking innovative thinking, ability and action, from the perspective of data technology application, actively optimize the functional structure of government departments, further optimize the division of responsibilities, give full play to the decentralized characteristics of digital and intelligent technology, improve the relationship between the government and citizens, improve the enthusiasm of the public to participate in government decision-making, and actively adapt to the trend of digital development, Aiming at the smooth flow of data resources, the department structure is reorganized and designed according to the government work process, so as to realize the integrated development of digital government service and government business process. As shown in Figure 2.

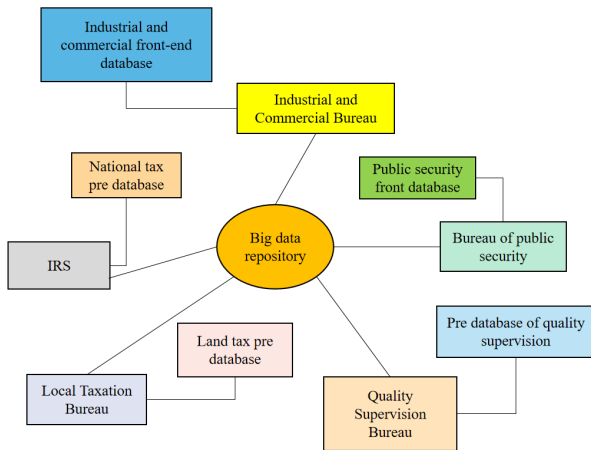


FIGURE 2. Schematic diagram of big data resource system.

The development of digital and intelligent technology has changed the government’s ability to gather and analyze information, improved the communication efficiency between departments, promoted business process reengineering, and resource integration and optimization, promoted the improvement of government decision-making, and provided the foundation for realizing inter-departmental and cross-level business collaboration and precise service. Promote the construction of digital government, promote modernization with intelligence, get out of the dilemma of “failure” of traditional government administration means by means of modern technology, crack the administration deficit, consolidate the ruling foundation and enhance the ruling ability.

**B. COMPARISON BETWEEN E-GOVERNMENT AND DIGITAL ADMINISTRATION**

Theoretically, e-government can be simply regarded as online and offline co assimilation of government affairs. It is the primary form of digital government transformation, but it is not equivalent to digital transformation. The basis of e-government is the extraction of traditional government core blocks and the online of government affairs. Digital transformation is the high-level version of e-government. In the era of e-government, the government’s administration behavior is mostly focused on E-government, that is, the way and method of simply moving offline government affairs to online processing. With the rapid progress of network technology and the continuous improvement of people’s living standards, the needs of society and citizens have gradually become diversified and deepened; therefore, this requires that digital administration must go through a complete digital transformation process in order to truly realize the intelligent e-government and serve the people, so as to continuously adapt and improve the digital government administration in the new era. Nowadays, e-government has penetrated into every corner of society. The development of E-government has ignited the “fuse” of social changes. The use of digital and intelligent means to support decentralization, process integration and reengineering is still in the exploratory stage. Backward system and mechanism, weak consciousness, inertial thinking and other factors restrict the supporting role of digitization in government process reengineering. As a high-level version of e-government, digital administration focuses more on the development of the change process, deeply reflects many development phenomena in the digital transformation, and how to improve the digital administration theory through the transformation.

**IV. SUGGESTIONS ON PROMOTING THE CONSTRUCTION OF DIGITAL GOVERNMENT IN GBA’S INFORMATIZATION ECOLOGICAL ENVIRONMENT**

**A. CONSTRUCTION OF DIGITAL GOVERNMENT IN THE INFORMATION ENVIRONMENT UNDER THE DIGITAL TRANSFORMATION OF GOVERNMENT**

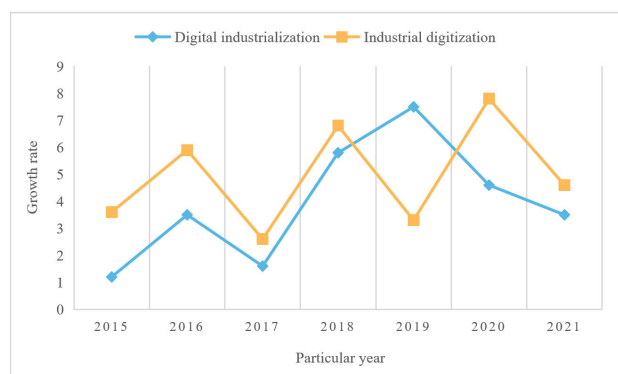
To improve the government’s administration ability through digitization and intelligence is to use technical means to promote the reform of the government system, promote the “release of management and service” and optimize the government’s operation mechanism. Most government departments do not fully realize this in promoting digital government service but simply introduce digital and intelligent technology and do not give full play to the role of digital technology in promoting government process reengineering. Focus on smart cities, increase the application of digital technology in government administration, and form a full coverage and grid modern government administration system. The profound motivation of government administration is technological innovation. From the agricultural society to the industrial society, and then to the information society, from the beacon to the telegraph and telephone, and then

to the optical fiber transmission, every major technological change not only profoundly changes society, but also urges the government to constantly respond to new challenges and embrace new technologies.

In the tide of economic globalization, digital administration is still in the stage of vigorous development. Combined with the actual national conditions of Chinese society, when implementing digital transformation, the government should not only prevent the conflict of new public management but also avoid the obstruction of the narrow view of technology application. Digital transformation of government is the basic work of developing DE and building a smart society, the inevitable choice of realizing high-quality economic and social development, and the effective starting point of promoting the modernization of government administration.

**B. EXPERIMENTAL RESULTS AND ANALYSIS**

The effect of government’s management and utilization of government data information has a significant impact on the quality of the overall digital government construction. The new requirements of the construction carrier operation have posed new challenges to the traditional government data management technology. In addition, many scholars have shown that the administration performance of smart government depends on whether the innovation of information technology is suitable for the adjustment of power structure. From 2015 to 2021, the scale of industrial digitization in Guangdong Province in 2019 will be 4.5% 2 trillion yuan, accounting for 66% of the overall scale of the DE, an increase of about 6 percentage points over 2017. The DE is gradually moving towards the deep integration of ICT industry and traditional industries, as shown in Figure 3.



**FIGURE 3. Digital industrialization and industrial digital structure changes in Guangdong province from 2015 to 2021.**

GBA is the largest Bay area with the largest population in the world, and it is also an urban agglomeration with the highest economic relevance with countries along the maritime Silk Road. In 2019, the GDP of GBA will reach US \$1.87 trillion, accounting for 11.54% of the country. In terms of a single economy, the economic scale of GBA ranks fourth in Asia after Japan, India, and South Korea. As far as the world’s metropolitan area is concerned, it ranks second only after the Tokyo metropolitan area. GBA district already has

the basic volume of a world-class Dawan district. As shown in Table 1.

**TABLE 1. Volume comparison between GBA and the third greater bay area in the world.**

Category	Tokyo Bay Area	New York Bay Area	San Francisco Bay Area	GBA; Greater Bay Area
Area (ten thousand square kilometers)	1.35	2.13	1.82	5.57
Population (ten thousand people)	4.394	2035	778	7268
GDP (trillions of dollars)	1.85	1.71	0.84	1.65
Per capita GDP (ten thousand dollars)	4.21	8.45	10.75	2.34

At present, the tertiary industry in Hongkong and Macau in GBA accounts for more than 92%, and the comprehensive proportion of tertiary industry in nine cities in Guangdong also reaches 56.8%. GBA has successfully realized the transformation and upgrading of the early complementary mode of industry and trade, formed a two-wheel-drive industrial system of advanced manufacturing industry and modern service industry, and possessed the super-influence and super-concentration industrial clusters required by the mature Bay Area. Three experiments were conducted in 2016 to 2021 respectively, and the experimental results are shown in Table 2, Table 3, and Table 4.

**TABLE 2. Statistics on the proportion of tertiary industry in GBA from 2016 to 2017.**

	The proportion of tertiary industry in 2016 (%)	The proportion of tertiary industry in 2017 (%)
Guangzhou	71.73	71.64
Shenzhen	58.75	60.96
Zhuhai	53.18	53.84
Foshan	42.05	42.36
Jiangmen	49.12	48.97
Huizhou	43.06	43.24
Zhongshan		
Proportion of tertiary industry in 2016 (%)	47.58	48.95

GBA has excellent port groups such as Hong Kong, Guangzhou, Shenzhen, Zhuhai, Zhongshan, and Nansha. The total container throughput of ports in the bay area exceeds five times that of the three major Bay areas in the world. Among them, Shenzhen port, Hong Kong port, and Guangzhou port have ranked among the top ten container throughputs in the world. The good Airport Group infrastructure has reached the all-around and efficient sea, land, and air three-dimensional transportation network required by the world-class mature Bay area. Two surveys were conducted, respectively, as shown in Table 5 and Table 6.

**TABLE 3. Statistics on the proportion of tertiary industry in GBA from 2018 to 2019.**

	The proportion of tertiary industry in 2018 (%)	The proportion of tertiary industry in 2019 (%)
Guangzhou	72.56	72.36
Shenzhen	59.47	61.35
Zhuhai	54.23	54.28
Foshan	43.14	43.65
Jiangmen	50.23	49.54
Huizhou	44.14	44.25
Zhongshan	48.63	49.47

**TABLE 4. Statistics on the proportion of tertiary industry in GBA from 2020 to 2021.**

	The proportion of tertiary industry in 2020 (%)	The proportion of tertiary industry in 2021 (%)
Guangzhou	73.56	73.48
Shenzhen	60.32	62.36
Zhuhai	55.14	55.47
Foshan	51.24	44.36
Jiangmen	45.58	50.24
Huizhou	46.98	45.87
Zhongshan	49.63	50.36

**TABLE 5. The first statistics of transportation flow of major ports and airports in GBA.**

City	Port cargo throughput (ten thousand tons)	Airport passenger flow (ten thousand passengers)
Hong Kong	26228	7156
Macao	-	968
Guangzhou	60620	7339
Shenzhen	25789	5346
Zhuhai	13845	1238

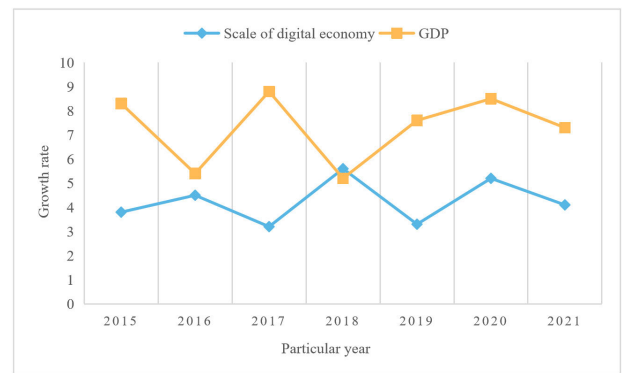
**TABLE 6. The second statistics of transportation flow of major ports and airports in GBA.**

City	Port cargo throughput (10000 tons)	Airport passenger flow (10000 person times)
Hong Kong	25728	7351
Macao	-	967
Guangzhou	61420	7436
Shenzhen	25873	5448
Zhuhai	14844	1358

GBA district has initially built efficient and fast infrastructure supporting facilities. The length of the expressway has reached more than 4000 km, making it the region with the highest density of Expressway facilities in China. The road network density between the core cities in the bay area exceeds that of the three world-class Bay areas. Facing the “coordinated development” dilemma of uneven regional development levels and unequal database sharing in the past government data management process, Guangdong Province is committed to building a digital government Cloud Architecture through the construction of the province’s government data intelligent cloud platform and technology upgrading, including building a solid basic support platform,

such as unified identity authentication, unified information portal Unify the government big data center, and build two platforms of technology and data to complete the matching between its own data management structure and the direction of digital government transformation.

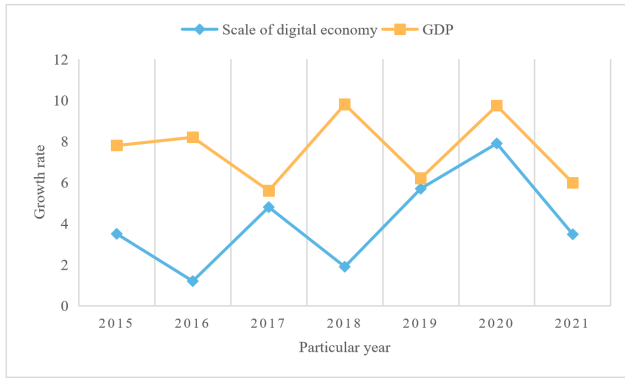
From 2015 to 2021, the scale of Guangdong’s DE was 5.78 trillion yuan, accounting for 14.6% of the national DE, up by 13.8% year-on-year, about 7 percentage points higher than the regional GDP growth rate in the same period, which was 1.65 times that of 2021, and the compound annual growth rate was as high as 18.5%, making it one of the highlands of China’s DE development. Three experiments were conducted for comparison, as shown in Figure 4.



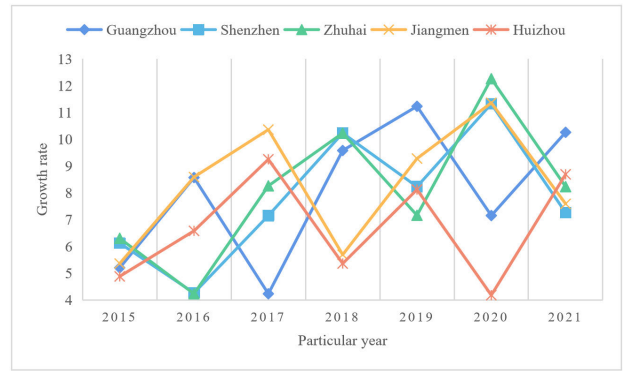
**FIGURE 4. Comparison of DE scale and regional GDP in Guangdong province from 2015 to 2021.**

The experimental results show that, as shown in Figure 4, the proportion of the DE in GDP in Guangdong Province has increased year by year, from 39% in 2015 to 58% in 2018, and its position in the economic growth of GBA has been increasing. The DE in Hong Kong has developed steadily, and the digital level of public services in Macao has been continuously improved. As shown in Figure 5, the proportion of DE in GDP in Guangdong Province decreased year by year from 2020 to 2021, from 80% in 2020 to 20% in 2021, and its position in the economic growth of GBA decreased. The DE in Hong Kong has developed steadily, and the digital level of public services in Macao has been continuously improved. As shown in Figure 6, the proportion of Guangdong’s DE in GDP increased from 31% in 2017 to 68% in 2018, and its position in the economic growth of GBA decreased. The DE in Hong Kong has developed steadily, and the digital level of public services in Macao has been continuously improved. To promote the digital transformation of the government is to accurately grasp the laws of macro and microeconomic operation, comprehensively improve the level of public services, and constantly enhance the digital, intelligent, and integrated service capacity of government departments.

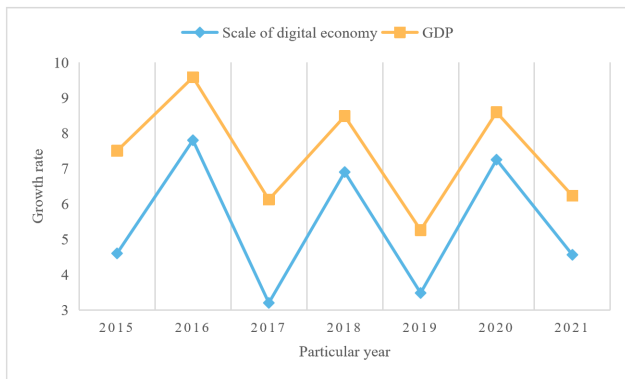
In the construction of digital government, we should not only learn from mature experience at home and abroad but also stick to our own path based on national conditions and realities, build a digital government framework that can give full play to the advantages of our system, embed information and communication technology into every corner of society,



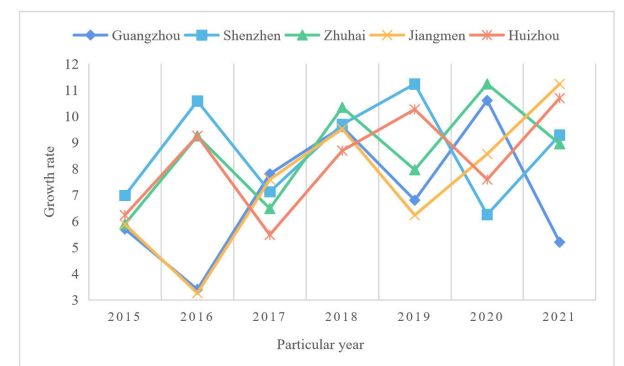
**FIGURE 5.** Comparison of DE scale and regional GDP in Guangdong province from 2015 to 2021.



**FIGURE 8.** Comparison of the second growth rate of DE and GDP among cities in Guangdong province.

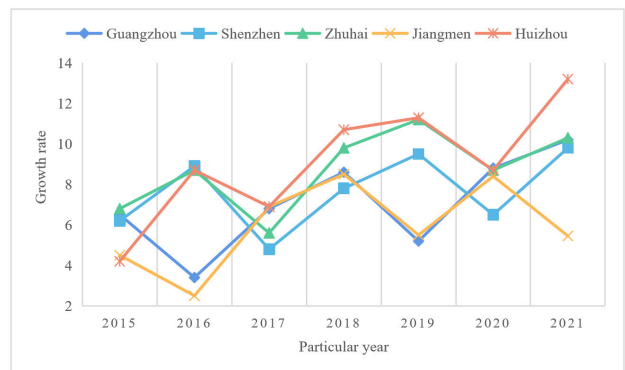


**FIGURE 6.** Comparison of DE scale and regional GDP in Guangdong province from 2015 to 2021.



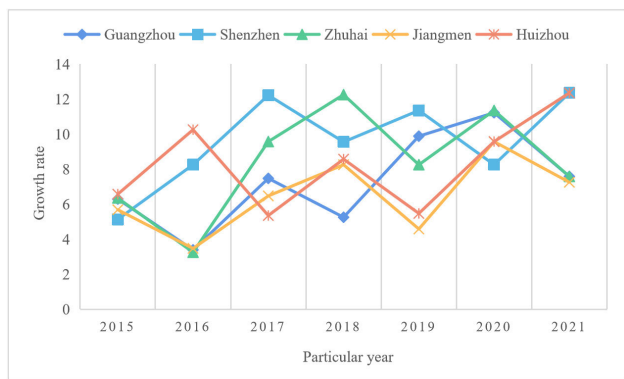
**FIGURE 9.** Comparison of the third growth rate of DE and GDP among cities in Guangdong province.

promote the deep integration of information technology and government administration, and comprehensively enhance the government administration capacity. From 2015 to 2021, the growth rate of the DE in most cities in Guangdong Province is significantly higher than the growth rate of local GDP. Four experiments were conducted in Guangzhou, Shenzhen, Zhuhai, Jiangmen, and Huizhou, as shown in Figures 7, Figures 8, Figures 9, and Figures 10.



**FIGURE 7.** Comparison of the first growth rate of DE and GDP among cities in Guangdong province.

The experimental results show the new development trend and pattern in the era of the DE. However, there is a big gap



**FIGURE 10.** Comparison of the fourth growth rate of DE and GDP among cities in Guangdong province.

in the growth rate of the DE among cities: the growth rate of the DE exceeds that of the national DE by 16.5% 6% growth rate; The growth rate of the DE in Guangzhou and Shenzhen is above 15%, which is within the rapid growth range; The growth rate of the DE in Huizhou and Jiangmen is less than 11%. The main reasons for the slow growth of these cities are: on the one hand, the number of digital enterprises is small, the overall scale is small, and the added value of products is low, which is very vulnerable to the external environment, resulting in unstable digital economic growth; On the other



hand, there is a lack of leading digital leading enterprises and related core industries.

## V. CONCLUSION

The new environment created in the digital age of information ecological environment affects the process of governance reform in Guangdong Province from three aspects: the guidance of construction concept, the adjustment of service mode and the renewal of carrier. The interconnection of infrastructure in GBA is conducive to promoting the dislocation development pattern of complementary functions and resource integration in core cities, and fully reflects the advantages and characteristics of different regions. In terms of concept, the information-based ecological environment is an effective way to seek the sustainable development of the city, which represents the development direction of the future city-towards the globalization of the industrial structure, the integration of information economy, the networking of transportation and communication, the regionalization of science and technology and culture, the ecological living environment, the flexibility of spatial structure, the modernization of group quality, the high efficiency of organization and management, and the informationization of competitiveness. For government departments burdened with heavy pressure of governance tasks, they also hope to enhance the social participation of enterprises and people in the process of digital government construction by using Internet thinking, so as to form a social consensus of collaborative governance, and create a service supply model that fully connects the government governance reform of the information ecological environment with the needs of many parties in society. Adhere to the problem orientation, deepen the high-level mutually beneficial cooperation between Guangdong, Hong Kong and Macao, give full play to the leading role of digital technology in the information ecological environment, vigorously develop the DE, promote the marketization of data elements, and improve the digital and intelligent level of public services and social governance in the information ecological environment.

## REFERENCES

- [1] S. Bresciani, K.-H. Huarng, A. Malhotra, and A. Ferraris, "Digital transformation as a springboard for product, process and business model innovation," *J. Bus. Res.*, vol. 128, pp. 204–210, May 2021.
- [2] I. Choi and M. C. Hoffman, "Bringing government into the 21st century: The Korean digital administration experience," *Public Admin. Rev.*, vol. 77, no. 5, pp. 794–796, 2017.
- [3] E. Hadjielias, O. L. Dada, A. D. Cruz, S. Zekas, M. Christofi, and G. Sakka, "How do digital innovation teams function? Understanding the team cognition-process Nexus within the context of digital transformation," *J. Bus. Res.*, vol. 122, pp. 373–386, Jan. 2021.
- [4] M. Wolski, M. Krahe, and J. Richardson, "A model for librarians to assess the digital capability of research teams," *J. Austral. Library Inf. Assoc.*, vol. 69, no. 1, pp. 47–69, Jan. 2020.
- [5] L. E. Opland, I. O. Pappas, J. Engesmo, and L. Jaccheri, "Employee-driven digital innovation: A systematic review and a research agenda," *J. Bus. Res.*, vol. 143, pp. 255–271, Apr. 2022.
- [6] L. Ryser, G. Halseth, and S. Markey, "Moving from government to administration: Addressing housing pressures during rapid industrial development in Kitimat, BC, Canada," *Housing Studies*, vol. 36, no. 14, pp. 1–26, 2020.
- [7] E. Sigalat-Signes, R. Calvo-Palomares, B. Roig-Merino, and I. García-Adín, "Transition towards a tourist innovation model: The smart tourism destination: Reality or territorial marketing," *J. Innov. Knowl.*, vol. 5, pp. 96–104, Apr. 2020.
- [8] D. Kuehn, "Government and administration of security: The politics of organized crime in Chile, by Carlos Solar," *Democratization*, vol. 26, no. 4, pp. 1–2, 2019.
- [9] S. Lee-Geiller and T. D. Lee, "Using government websites to enhance democratic e-governance: A conceptual model for evaluation," *Government Inf. Quart.*, vol. 36, no. 2, pp. 208–225, Apr. 2019.
- [10] I. Holliday and R. C. W. Kwok, "Administration in the information age: Building e-government in Hong Kong," *New Media Soc.*, vol. 6, no. 4, pp. 549–570, 2004.
- [11] L. S. Jensen, "The state, and administration," *Polity*, vol. 40, no. 3, pp. 379–385, 2008.
- [12] M. Skare and D. R. Soriano, "How globalization is changing digital technology adoption: An international perspective," *J. Innov. Knowl.*, vol. 6, no. 4, pp. 222–233, Oct. 2021.
- [13] I. Choi, "Digital era governance: IT corporations, the state, and e-government," *Int. Rev. Public Admin.*, vol. 21, no. 4, pp. 359–361, Oct. 2016.
- [14] S. Sultan Al-Ruzaiqi and Y. Baghdadi, "Government approach to integration in Oman," *IT Prof.*, vol. 18, no. 4, pp. 10–13, Jul. 2016.
- [15] G. Doukidis, D. Spinellis, and C. Ebert, "Digital transformation—A primer for practitioners," *IEEE Softw.*, vol. 37, no. 5, pp. 13–21, Sep. 2020.
- [16] M. Kassen, "Building digital state: Understanding two decades of evolution in Kazakh e-government project," *Online Inf. Rev.*, vol. 43, no. 2, pp. 301–323, Apr. 2019.
- [17] R. A. Chazal and A. Poppas, "Administration transformation: On the path toward a more nimble, strategic college," *J. Amer. College Cardiol.*, vol. 68, no. 7, pp. 763–765, 2016.
- [18] M. M. Nyanchoga, P. Lee, and G. Barbery, "Exploring electronic health records to estimate the extent of catch-up immunisation and factors associated with under-immunisation among refugees and asylum seekers in south east Queensland," *Vaccine*, vol. 39, no. 42, pp. 6238–6244, Oct. 2021.
- [19] S. Yin, B. Li, and Z. Xing, "The governance mechanism of the building material industry (BMI) in transformation to green BMI: The perspective of green building," *Sci. Total Environ.*, vol. 677, pp. 19–33, Aug. 2019.
- [20] W. U. Lihua, M. A. Tianshu, Y. Bian, L. I. Sijia, and Y. I. Zhaoqiang, "Improvement of regional environmental quality: Government environmental governance and public participation," *Sci. Total Environ.*, vol. 717, no. 5, 2020, Art. no. 137265.
- [21] N. Wang, M. Ma, G. Wu, Y. Liu, Z. Gong, and X. Chen, "Conflicts concerning construction projects under the challenge of cleaner production—case study on government funded projects," *J. Cleaner Prod.*, vol. 225, pp. 664–674, Jul. 2019.
- [22] Y. Wang, Y. Chen, W. Wang, Y. Chen, and M. Jin, "Revisiting the relationship between contract administration and contractors' opportunistic behavior in construction projects," *IEEE Trans. Eng. Manag.*, vol. 69, no. 6, pp. 2517–2529, Dec. 2022.
- [23] J. P. Trovao, "Digital transformation, systemic design, and automotive electronics [automotive electronics]," *IEEE Veh. Technol. Mag.*, vol. 15, no. 2, pp. 149–159, Jun. 2020.
- [24] B. Panda and M. J. Tan, "Rheological behavior of high volume fly ash mixtures containing micro silica for digital construction application," *Mater. Lett.*, vol. 237, pp. 348–351, Feb. 2019.
- [25] S. P. Bhavnani, K. Parakh, A. Atreja, and R. Druz, "2017, Roadmap for innovation-ACC health policy statement on healthcare transformation in the era of digital health, big data, and precision health: A report of the American college of cardiology task force on health policy statements and systems of care," *J. Amer. College Cardiol.*, vol. 70, no. 21, pp. 2696–2718, 2017.
- [26] L. Yuan, H. Li, S. Fu, and Z. Zhang, "Learning behavior evaluation model and teaching strategy innovation by social media network following learning psychology," *Frontiers Psychol.*, vol. 13, Jul. 2022, Art. no. 843428, doi: 10.3389/FPSYG.2022.843428.



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