



Evaluation of the Level of Smart City Construction Based on Guangfo-Shenzhen-Dongguan in the Context of Guangdong-Hong Kong Macao Greater Bay Area

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ABSTRACT

The Guangdong Hong Kong-Macao Greater Bay Area is one of the most open and economically dynamic regions in China. The construction of a new type of smart bay area is an important part of the Guangdong-Hong Kong-Macao Greater Bay Area strategy, and the construction of a smart bay area needs to be closely integrated with international standards and focus on building a smart digital centre in the

Greater Bay Area. This study focuses on the development needs, future development trends and construction strategies of smart cities in four city clusters in the Guangdong-Hong Kong-Macao Greater Bay Area from four development perspectives: smart water conservancy, smart cultural tourism, smart transportation and smart healthcare, using data related to the development of smart cities in Guangzhou-Foshan-Shenzhen-Dongguan in recent years, the entropy weighting method is used to determine the weights of 40 indicators, and the TOPSIS evaluation model is applied to evaluate the level of smart city construction in each city. The evaluation of the level of smart city construction in each city was carried out by using the TOPSIS evaluation model, and it was concluded that there were large differences among the cities, and there was a need for city-specific policies and reasonable improvements. The evaluation of the level of smart city development in each city was carried out using the TOPSIS evaluation model.

Keywords: Guangdong Hong Kong -Macao Greater Bay Area, Smart Water, Smart Culture and Tourism, Smart Transportation, Smart Healthcare, Smart City Construction Level Evaluation¹

INTRODUCTION

As a national reform and opening-up early zone and an important engine of economic development, Guangdong-Hong Kong-Macao Greater Bay Area is ahead of the rest of the country in building technology and industrial innovation centers and bases for advanced manufacturing and modern service industries, reaching the organic integration of Internet, Internet of Things, communication networks and cable TV networks, and forming a strong infrastructure network. The government actively promotes the development of smart cities, and from 2014 "Guidance on Promoting the Healthy Development of Smart Cities" there are constantly active policies to promote the reform of wisdom around the world, trying to solve a series of problems encountered in the development of urbanization from another side. Some local governments have adopted the attitude of blindly following the trend, without an in-depth analysis of the construction of their smart cities, copying the construction plans of other cities into their construction, which eventually makes the construction of smart cities around the world more or less the same.

In the process of promoting the "people-oriented, user-oriented" smart city construction, the quality of the simultaneous construction of a smart society will directly affect the quality of life and experience of residents. As one of the regions with the highest degree of openness and economic vitality in China, the Guangdong-Hong Kong-Macao Greater Bay Area has an important strategic position in the country's overall development. The Guangzhou-Foshan and Shenzhen-Dongguan city pairs ranked first and second respectively in the "2020 Third Quarter National City Linkage" ranking, and their economic development and urban influence is the "leading city in the Bay Area". However, the unbalanced development of urban clusters within the region of Guangdong-Hong Kong-Macao Greater Bay Area is one of the important challenges faced in the process of building a smart society in the region. Facing the problems of administrative division management, cultural differences, and unbalanced economic development in Guangdong-Hong Kong-Macao Greater Bay Area, political enterprises are needed to solve the challenges and problems in the construction of a smart society in a more

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intelligent way. How to improve the smart city construction of the leading cities in the Bay Area and create a benchmark city to drive other cities to improve the level of smart city construction has become an urgent problem to be solved in Guangdong-Hong Kong-Macao Greater Bay Area. There are many analyses about the connotations of smart cities at present, but no unanimous consensus has been formed. The research on smart city construction by domestic and foreign scholars can be broadly divided into two aspects: one is to study the construction mode of smart cities, and the other is to study the evaluation system of smart cities. As for the research on the mode of smart city construction, Wang Juan (2014) proposed that the mode of smart city construction should be driven by innovation, with smart industry as the forerunner and technology as the basis, and the government as the leading gradually guiding enterprises and public participation from the demand of city characteristics. After comparing and analyzing the typical development models of smart cities at home and abroad, Zhang Hong et al. (2014) concluded that the construction model of smart cities should be divided into four categories: government independent investment in network construction, operator-independent investment in network construction, government planning guiding operator investment in network construction, and the model of government partially funding and entrusting operator network construction. In the study of the smart city assessment system, the concept of "smart city" was first proposed by IBM in 2008, and there is no authoritative index and system for the assessment of the level of urban wisdom. Deng Xianfeng (2010) constructed a wisdom city evaluation index system from four dimensions: network interconnection, wisdom industry, wisdom service, and wisdom humanity, and analyzed the data of Nanjing city to summarize 21 indexes. Qu Yan (2017) argues that city construction is a dynamic process, and the assessment of smart city construction level needs to be based on five dimensions: smart technology infrastructure construction, management system construction, economic investment, social risk governance, and sustainable development strategy, and the regional characteristics presented by the construction level among cities are divided into three types of smart city construction: leading, catching up and developing. The research at home and abroad is still in the exploratory stage, and the research is scattered and has not yet formed a system, and each assessment system focuses on different contents and has different advantages and disadvantages.

The problems faced are mainly: more qualitative research, not enough quantitative analysis of the research. Most of the studies focus on the proposed and construction of the smart city index system, and relatively little research on the construction method of the index system and the evaluation method and measurement model of the smart city construction level, which will inevitably affect the reliability of the index system and the scientificity of the evaluation results. And there are a few research scholars through quantitative analysis methods and the establishment of models to carry out systematic analysis, but the regional relevance of the study is not strong, and the significance of the reference to the development of the city cluster driven by Guangzhou-Foshan-Shenzhen- Dongguan in the context of the current Guangdong-Hong Kong-Macao Greater Bay Area is not high, and the application of realistic significance is not high. In a comprehensive view, the overall evaluation index system of smart city construction level is lacking, and a more systematic and complete policy framework system has not yet been formed. The article intends to take Guangzhou-Foshan-Shenzhen-Dongguan as an example, evaluate the differences in the appropriate consumption level of each city within the city cluster, and study the possibility and policy guidelines for taking the lead in building a smart city cluster in the Guangdong-Hong Kong-Macao Greater Bay Area.

DATA SOURCE AND RESEARCH METHODOLOGY

(i) Data sources

The data for this study were obtained from *The Statistical Yearbook of Guangdong Provincial Bureau of Statistics 2019*, *The Statistical Bulletin of National Economic and Social Development of Guangdong 2019* and relevant data from the Bureau of Culture, Radio, Television, Tourism and Sports, Water Resources Bureau, Rail Transit Bureau, Transportation Bureau, Medical Security Bureau, etc. And the Internet date of Guangzhou, Foshan, Shenzhen, and Dongguan.

(ii) Research methodology

Entropy method

The entropy weight method is an objective assignment method, different from indicator weight calibration methods with high subjectivity such as hierarchical analysis. In the specific use process, the entropy weight method uses the information entropy to calculate the entropy weight of each indicator according to the dispersion degree of the data of each indicator and then makes certain corrections to the entropy weight according to each indicator, to obtain a more objective indicator weight. The main process of the entropy weighting method is as follows.

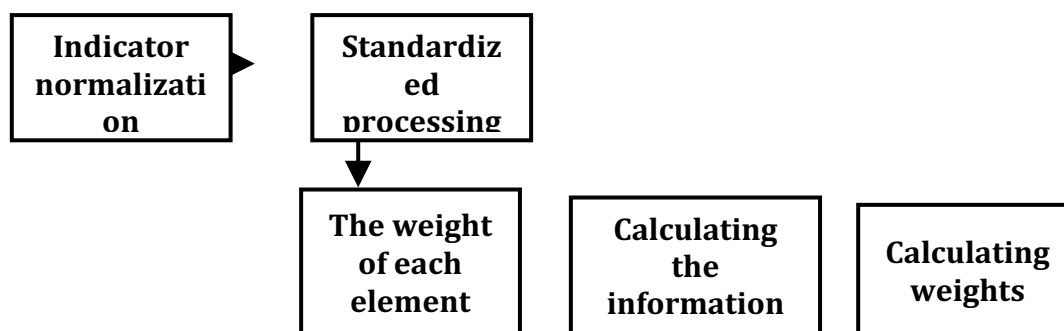


Figure1. Flow chart of entropy method

Indicator normalization

The indicator normalization operation converts all indicators into common indicators, i.e. the larger the better, to facilitate the subsequent calculation operation. In this experiment, the main use of the indicator forwarding operation is to transform the very small indicators into very large indicators, such as water quality control, water quality categories, non-compliance status, etc. in the river and lake quality of intelligent water resources, and traffic safety and environmental protection of intelligent transportation, road safety, and other indicators are very small indicators, that is, the smaller the value the better. The transformation used in this experiment is that each value in this indicator is replaced by the difference between the maximum value and that value, as shown in equation (1).

$$x_i = \max\{x_1, x_2, \dots, x_i\} - x_i \quad (1)$$

Standardized processing

The purpose of standardization is to balance the difference between the indicators or the error caused by the magnitude. For example, the values of Weibo, Zhihu, and topic popularity indicators of Tik Tok in this experiment are as high as 600-700 million in smart tourism, while the value of tourism as a proportion of GDP is decimal, and the difference in magnitude is large,

which has a large impact on the calculation, so the indicators need to be standardized. The standardization used in this experiment is shown in equation (2), where μ is the mean and σ is the variance.

$$x_i = \frac{(x_i - \mu)}{\sigma} \quad (2)$$

The weight of each element

The weight of the i th sample under the j th indicator is calculated and regarded as the probability used in the relative entropy calculation, and the probability matrix is calculated as shown in equation (3).

$$p_{ij} = \frac{z_{ij}}{\sum_{i=1}^n z_{ij}} \quad (3)$$

Calculating the information entropy of each index

The information entropy of each indicator is calculated and the information utility value is calculated as shown in equation (4).

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad (i = 1, 2, \dots, m) \quad (4)$$

Calculating weights

The information utility value is first calculated as in equation (5), and then normalized to the information utility value as in equation (6), and the resulting weight is the weight.

$$d_j = 1 - e_j, \quad (j = 1, 2, \dots, m) \quad (5)$$

$$w_j = \frac{d_j}{\sum_{j=1}^m d_j}, \quad (j = 1, 2, \dots, m) \quad (6)$$

TOPSIS (Superior-Inferior Solution Distance Method)

TOPSIS method, called Technique for Order Preference by Similarity to an Ideal Solution, is a common comprehensive evaluation method that can make full use of the information of the original data, and the results can accurately reflect the gap between the evaluation solutions. The process of the TOPSIS method is as follows.

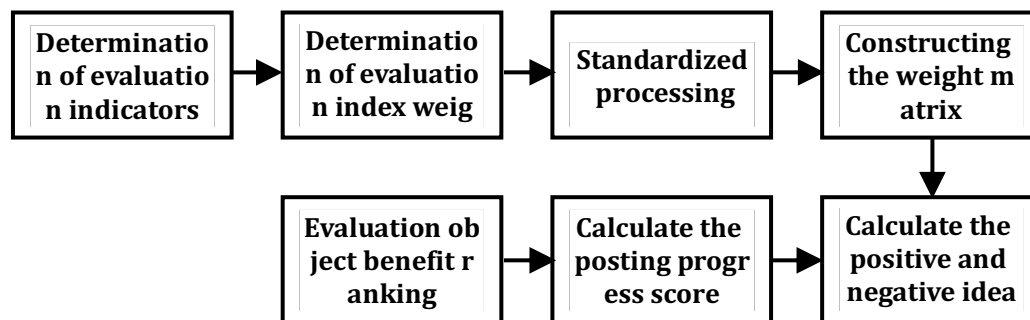


Figure2. TOPSIS method flow chart

In this experiment, the entropy weight method proposed in 2.1 is used to complete the steps before "calculating the positive and negative ideal distances" in TOPSIS and construct the weight matrix of each index, and then calculate the distances D_i^+ and D_i^- of each object from the maximum and minimum values respectively according to the weights, as shown in equation (7) (8).

$$D_i^+ = \sqrt{\sum_{j=1}^m w_j (Z_i^+ - z_{ij})^2} \quad (7)$$

$$D_i^- = \sqrt{\sum_{j=1}^m w_j (Z_i^- - z_{ij})^2} \quad (8)$$

The score is then calculated according to equation (9).

$$S_i = \frac{D_i^-}{D_i^+ + D_i^-} \quad (9)$$

Finally, the scores are normalized so that the resulting scores are between 0 and 1 and are ranked as shown in equation (10).

$$\tilde{S}_i = \frac{S_i}{\sum_{i=1}^n S_i} \quad (10)$$

Construction of evaluation index system

(i) Principles for selecting indicators

Based on the relevant analysis of the connotation and constituent elements of smart city, four first-level indicators, 12 second-level indicators and 40 third-level indicators are selected according to the principles of representativeness, independence and quantification to establish the evaluation index system of smart city construction level. The principle of representativeness refers to the selection of representative indicators through the analysis of the connotation and constituent elements of smart city, striving to comprehensively reflect the construction level of smart city; The principle of independence refers to the relative independence of each indicator, and there should be a clear boundary between indicators, not vague; The principle of quantification means that the selected indicators can be measured by numerical values, which can reflect the construction level of smart cities sensitively and effectively. On the basis of establishing the evaluation index system of smart city construction level, this paper uses entropy weight method to determine the weight of each index.

Smart city construction is a systematic project, involving the main factor of the government, enterprises, citizens, and so on. This article's smart city construction level evaluation index system of building is in the connotation and constituent elements of smart city based on correlation analysis, based on the related literature and research results of sorting, induction, smart city construction can be found from several aspects. The text will evaluate the construction of smart cities from four aspects: smart medical treatment, smart cultural travel, smart transportation and smart water conservancy.

(ii) Indicator measurement

With entropy weight method, the key factors contributing to each characteristic of smart city construction are established as shown in Table 1.

Table 1. Smart city construction assessment indicator and their weights

first-level indicator	second-level indicator	third-level indicator	weight
Smart Water	Water supply distribution	Urban water consumption	0.0055474
		Rural water consumption	0.04559041
		Industrial water consumption	0.00378951
		Agricultural water consumption	0.01844646
		Ecological water consumption	0.01266201
		The others	0.01143427
	The quality of lakes and rivers	Water quality control	0.03205394
		The water quality category	0.02844686
		The situation of not up to standard	0.24855409
	The quality of drinking water	The water quality category	0.1375741
		The situation of not up to standard	0.02827496
	Soil and water conservation	terraced fields	0.08946026
		Soil and water conservation forest	0.07022373
		Economic forest	0.03591868
		Seeding grass	0.00104333
		closing hillside for erosion control	0.11598283
		Other measures	0.11499717
Smart Culture and Tourism	Smart scenic spot	The coverage rate of WiFi	0.000197716
		Total number of exhibitions held in key venues	0.232142640
		Urban green coverage	0.0105620357
		Tourism Resource Index	0.0306029844
	Smart tourists	The number of passengers	0.0780589351
		5G mobile phone usage rate	0.207890992
		Total annual passenger transport	0.131768671
	Smart administration	The heat of topic in Weibo, Zhihu and TikTok	0.139622176
		Information platform construction	0.0601365512
		The proportion of tourism in Gross Domestic Production (GDP)	0.0231167265
		Total revenue of city tourism	0.0859005724
Smart Healthcare	Smart hospital management	The number of devices	0.13653031
		The allocation rate of equipment	0.00779524
	Regional health Management	Graded diagnosis and treatment rate	0.37513637
		Online appointment rate	0.13536171
		Coverage rate of family doctors	0.34517638

Smart Transportation	Infrastructure and travel services	The quantity of passenger transport turnover	0.30406242
		Road network density	0.11796843
		The quantity of civil car ownership	0.00335015
	Smart traffic management level	The number of parking lots	0.05146828
		Peak Congestion index	0.15545675
	Traffic safety and environmental protection	Road traffic safety	0.14352749
		The quantity of new energy vehicle ownership	0.22416648

iv. results and analysis recommendations

Using the TOPSIS evaluation model, the results of the evaluation of smart water resources, smart cultural tourism, smart healthcare and smart transportation in the four leading cities in the Guangdong-Hong Kong Macao Greater Bay Area were derived and the cities were ranked on each indicator, and the level of smart city construction in the four cities was ranked according to the comprehensive score index, as shown in Table 2.

Table 2 .Evaluation results of the level of smart city construction in the four cities

City	Smart water				Smart Culture and Tourism			
	Optimum solution	The worst solution	Overall Score Index	Sort by	Optimum solution	The worst solution	Overall Score Index	Sort by
Guangzhou	0.59223	0.68434	0.53607	2	0.09590	0.77753	0.89020	1
Shenzhen	0.79809	0.39275	0.32981	3	0.53893	0.46341	0.46232	2
Foshan	0.58810	0.90322	0.60564	1	0.80232	0.04175	0.04947	3
Dongguan	1.00543	0.38321	0.27596	4	0.79721	0.03471	0.04173	4
City	Smart Healthcare				Smart Transportation			
	Optimum solution	The worst solution	Overall Score Index	Sort by	Optimum solution	The worst solution	Overall Score Index	Sort by
Guangzhou	0.23514	0.64065	0.73150	1	0.34954	0.61195	0.63645	2
Shenzhen	0.33278	0.58838	0.63874	2	0.27031	0.61702	0.69536	1
Foshan	0.64295	0.15103	0.19022	3	0.68582	0.27382	0.28533	3
Dongguan	0.77384	0.00992	0.01265	4	0.70187	0.22117	0.23961	4
City	Evaluation results of the level of smart city construction							
	Optimum solution		The worst solution	Overall Score Index		Sort by		
Guangzhou	0.025649		0.747701	0.966833		1		
Shenzhen	0.308778		0.505769	0.620920		2		
Foshan	0.688497		0.133091	0.161992		3		
Dongguan	0.744469		0.045724	0.057864		4		

(i) Overall assessment

According to the comprehensive evaluation results of smart cities, it can be found that the comprehensive score of Foshan and Dongguan 5 smart city construction level is low, indicating that the degree of smart construction in these two cities needs to be improved. Guangzhou has the highest overall score of 0.967, followed by Shenzhen with an overall score index of 0.621, while Foshan and Dongguan are both below 0.2 and the extreme difference between the first two and the latter two is very large reaching over 0.9. Guangzhou, as a national central city, has developed over the years and has certain economic, policy and information infrastructure foundations and advantages for building a new and vast project of smart city, and is far ahead of the other three cities with a score of 0.9. In the past decade, Shenzhen Telecom has achieved full optical network coverage and the average network speed is among the highest in China. Successfully built out an open information platform. Shenzhen, as a pioneering demonstration zone, has continued to develop and improve its wisdom, with an overall score of 0.6. Foshan, the third city in the overall ranking, scored 0.162, far lower than Guangzhou and Shenzhen, but a comparison of the scores of the four dimensions of evaluating smart cities also shows that Foshan's smart water project is higher than the other three cities, while Dongguan's overall score is only 0.058, the lowest among the four cities. Dongguan has the lowest overall score of the four cities, indicating a low level of wisdom in the city.

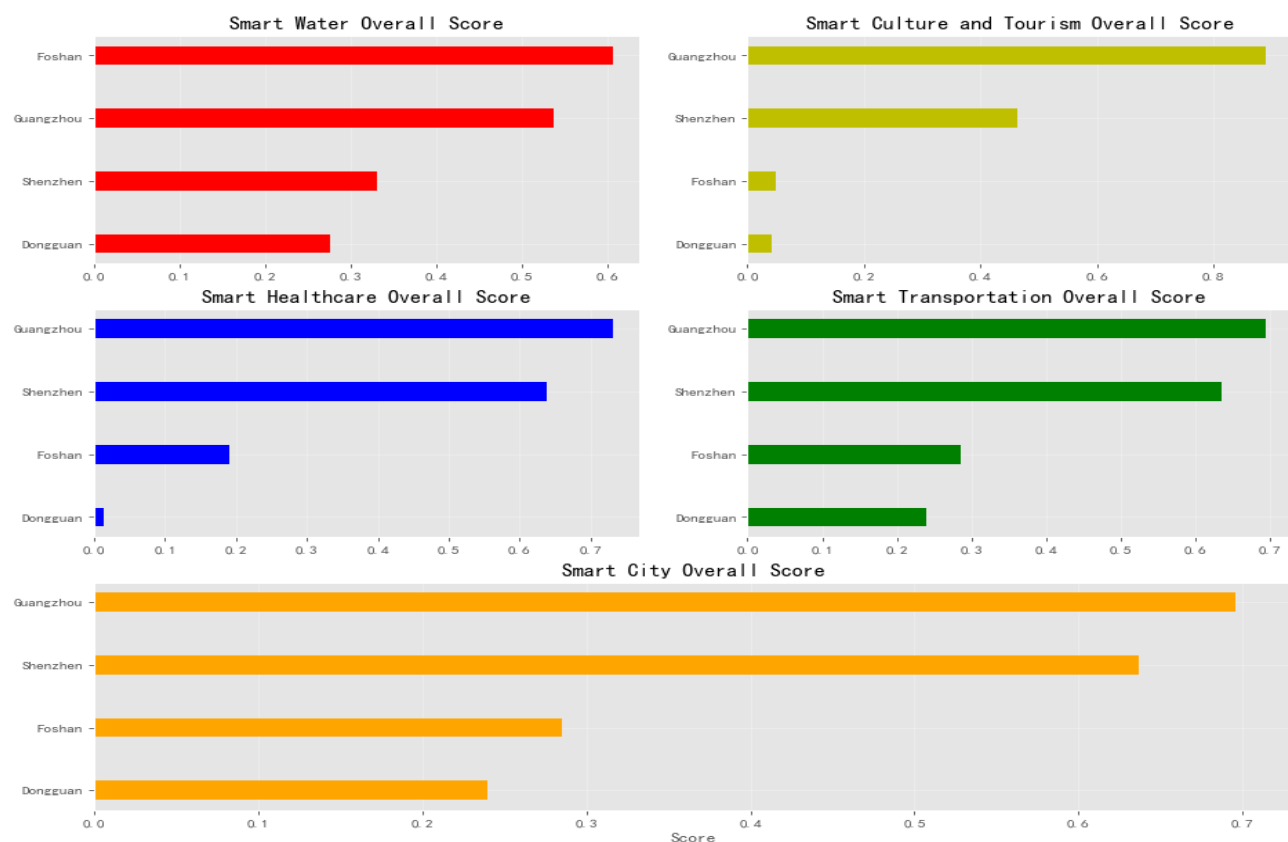


Figure 3-1. Overall score

(ii) Smart Water Analysis and Recommendations

In terms of smart water scores, all cities except Dongguan scored above 0.5, with Foshan scoring 0.606, the highest smart water score of the four cities. In terms of the indicators that

reflect smart water conservation, soil and water conservation has the highest weighting at 0.428, followed by the quality of rivers and lakes at 0.309. Combining the four cities' water supply security, water distribution and problem solving, it can be seen that soil and water conservation largely reflects the water conservation situation in each city, and that it is only when improving the smart system platform that the water conservation foundation, good or poor, can be better targeted. It is possible to refine the intelligent system platform in a more targeted manner. The data for the last five years also shows that the security of water supply (quality of rivers and lakes, safety of drinking water) is gradually improving, and that the distribution of water sources is also distinctive (urban water use is significantly higher in Shenzhen than in the other three cities, and agricultural water use is significantly higher in Foshan than in the other three cities), reflecting the development priorities of each city.

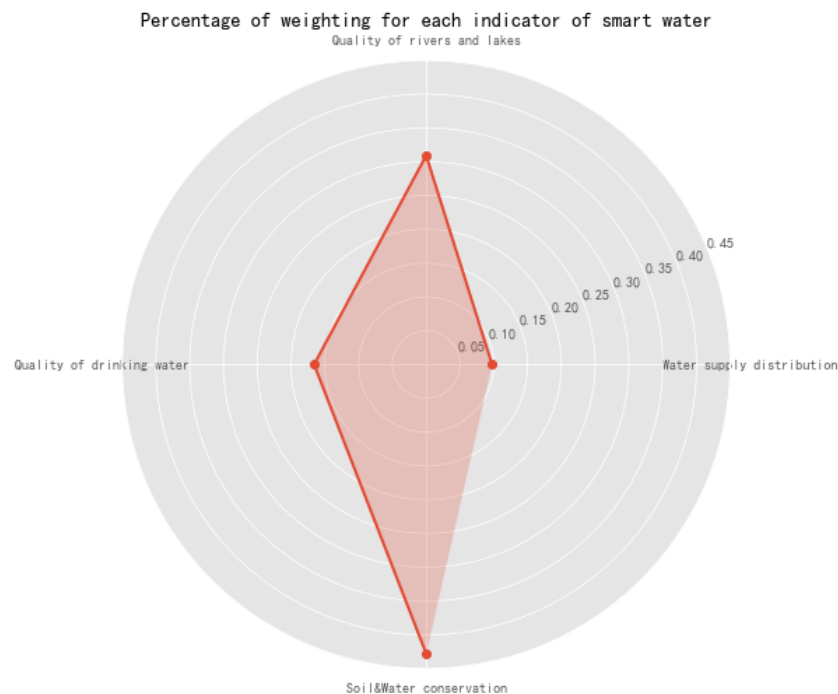


Figure 3-2. Weightings for each of the smart water resources

2017 was a big year for soil and water management, totalling 7,323.91 square kilometres in all aspects of terracing, soil and water conservation forestry and economic forestry, greatly surpassing subsequent years. During the year, Foshan City focused on managing soil and water conservation forests, totalling 1,810 square kilometres. Guangzhou focused on closure management and other measures, totalling 4,747.64 square kilometres. In subsequent years, although Foshan City ranked in the bottom two or three in terms of soil and water management, it was the best in terms of soil and water management overall, as it had the least soil erosion of the four cities. In view of the good foundation of soil and water situation in Foshan, it is possible to integrate data from all regions, improve the operation and management system of soil and water conservation information, perceive the situation of soil and water conservation in all regions in real time, strengthen the construction of information platforms, realise online information sharing, convey all kinds of information to users faster, and also make it easier for citizens and the government to implement supervision. In the case of Guangzhou and Shenzhen, two cities where the information platform is already well developed and mature, soil erosion is

too serious resulting in soil and water conservation not being able to match that of Foshan City even though it is strengthened every year. Therefore, we suggest that during the construction process of economic development, natural factors such as soil and water should also be taken into account, especially at a later stage of development, and that the authorities of various industries such as transport, housing, urban management and public services should be coordinated to incorporate the approved of the soil and water conservation plan into the preliminary design and construction drawing design aspects of the main project of each project, incorporate the content and requirements of soil and water erosion prevention and control during the construction period into the format text of the design, supervision and construction contract, compact the main responsibility of the construction unit, and establish a long-term management mechanism for soil and water conservation under the joint control of the whole industry. For Dongguan City, where mild soil erosion accounts for a relatively large proportion, it can first learn from the methods of soil and water management in the first three cities, and then gradually improve the establishment of an information platform to improve the real-time nature if process tracking.

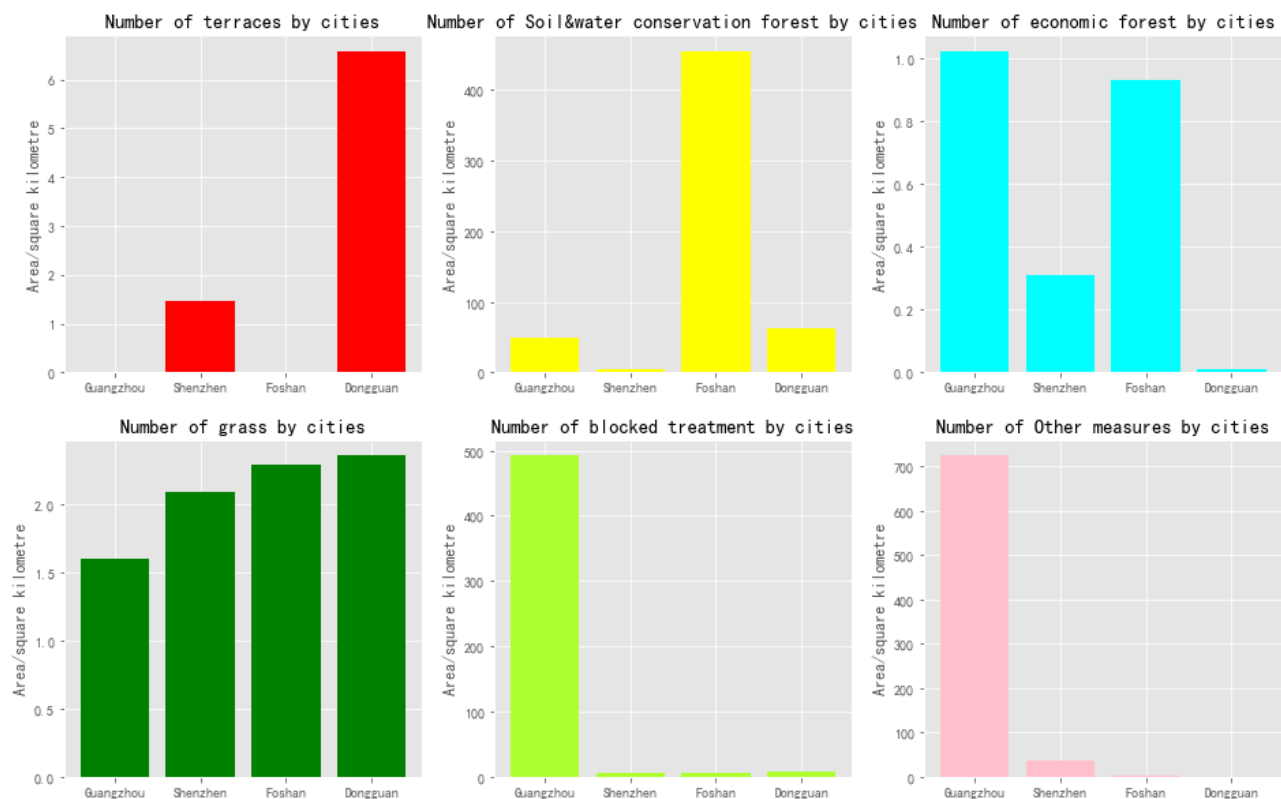


Figure 3-3. Indicators of smart water in different cities

(iii) Smart Culture and Tourism Analysis and Recommendations

In the comprehensive rating of intelligent cultural tourism in the four Guangdong-Hong Kong-Macao Greater Bay Area of Guangzhou, Shenzhen, Foshan and Dongguan, Guangzhou ranked first with an overall score index of 0.89020, with a score much worse than Shenzhen, which ranked second, reflecting that Guangzhou is a unique level in the development of intelligent cultural tourism in the Guangdong Hong Kong Macao Greater Bay Area, which, admittedly, is also influenced by Guangzhou as the provincial capital city with sufficient cultural heritage and

tourism This is also due to the fact that Guangzhou, as the capital city of the province, is rich in cultural heritage and tourism resources, which has contributed greatly to the development of cultural tourism. In this regard, Foshan and Dongguan need to increase the construction of intelligent cultural tourism, both cities are lacking in this area and can learn from the development experience of Guangzhou Shenzhen.

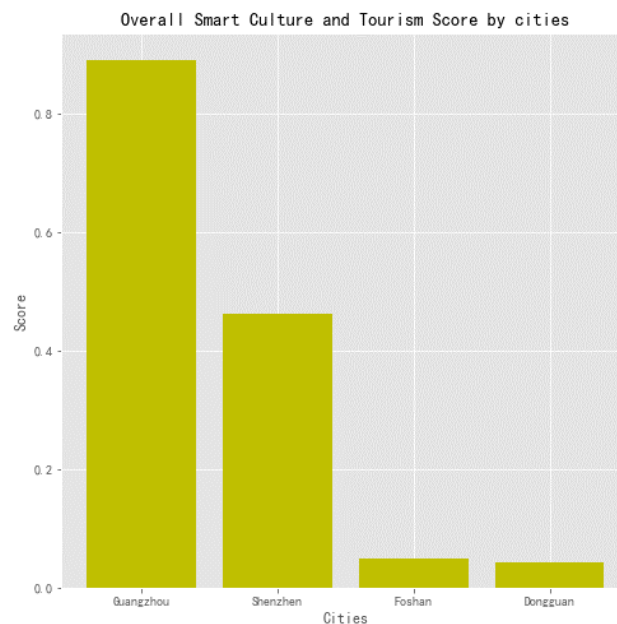


Figure 3-4. Overall smart tourism score by city

Based on the era of popularisation of tourism, we should take advantage of the new trend of integration of the three industries, accelerate the transformation and upgrading of the tourism industry, continuously enrich the content of tourism in the Greater Bay Area, enhance the level of basic services of the tourism industry, actively encourage the reasonable flow of capital and technological factors from Hong Kong and Macau to the neighbouring cities such as Guangzhou, Shenzhen and Zhuhai, and make good use of the overall layout of tourism in the Greater Bay Area to segment the tourism market in the Greater Bay Area, such as study tourism for the post-80s and post-90s, recreation and leisure tourism for the elderly, rural farming tourism and ocean cruise tourism. The tourism market in the Greater Bay Area should be well segmented based on the overall layout of the tourism industry in the Greater Bay Area, such as study tourism for the post-80s and post-90s, recreation tourism for the elderly, recreational and cultural tourism, rural farming tourism, and marine cruise tourism, etc. Guangdong, Hong Kong and Macao should actively collaborate to build a new situation for the comprehensive development of the tourism industry. Under the current favourable conditions of policy support, openness to the outside world and the gathering of innovative elements, it is important to recognise the new opportunities. Cities with a low level of tourism development should seize the historical opportunities and reasonably extend the tourism industry chain, based on the current new tourism industry development in Guangdong, Hong Kong and Macau. The tourism industry in the Greater Bay Area should be optimised, transformed and upgraded and developed in a sustainable and high-quality manner.

(iv) Intelligent Transport Analysis and Recommendations

Shenzhen has the highest overall score of 0.63645 in the construction of smart transportation, which is related to the fact that Shenzhen has been making every effort to promote the wisdom of urban transportation in recent years, and its metro construction and promotion of new energy vehicles are also the best developed among the four cities, which can be used as a reference for the other three cities in the construction of smart transportation. Guangzhou and Shenzhen are not far apart and can be said to be neck and neck in terms of smart transport development in terms of scores, but still lacking in the handling of peak congestion.

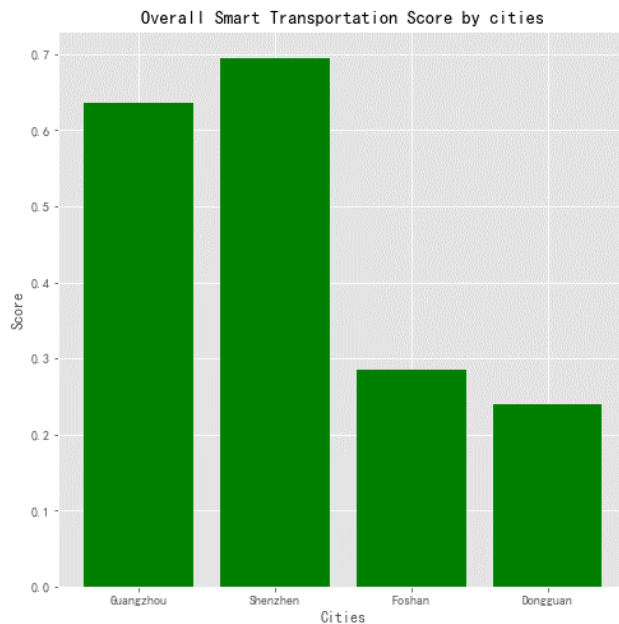


Figure 3-5 Overall Smart Transportation Score by City

To strengthen the high-speed direct connection between the Bay Area and strategic city clusters as a requirement, and to promote the formation of a multi-point access, multi-directional penetration high-speed railway network in the Bay Area, using "split-line transport" as the organising mode. At present, Guangzhou and Shenzhen have a strong demand for inter city connections, taking up a large amount of railway channel resources. The utilization rate of the two railway channels, Guangzhou-Shenzhen-Hong Kong Passenger Line and Guangzhou-Shenzhen Line 4, has exceeded 77%, making it difficult for the core cities of the Bay Area to provide more adequate capacity for medium and long-distance high-speed railway transport. It is suggested that the new round of external railway layout planning in the Greater Bay Area should focus on multi point access, emphasising the same access to multiple centres such as Guangzhou and Shenzhen at the same time, while actively planning for a multi-hub system in the Greater Bay Area in conjunction with new access, and enhancing the effectiveness of railway hub services. With the core objective of optimising the spatio-temporal relationship in the Greater Bay Area, and in accordance with the concept of integrated transport, we will start with intercity railways, urban rail express lines and urban rail trunk lines to build a composite rail system that supports the compact spatial development of the Bar Area and intensively meets regional travel needs. The focus will be on intercity railways to achieve fast and direct connections between important nodes within the Greater Bay Area, and on urban express

railways to ensure spatial and temporal accessibility between suburban areas of the metropolitan area and the core area.

(v) Smart Healthcare Analysis and Recommendations

According to the overall score of smart healthcare, Guangzhou ranked first with a score of 0.731 and Shenzhen ranked second with a score of 0.639. The other two cities were below 0.2, which indicates that the smart healthcare aspects of Foshan and Dongguan need to be strengthened. Smart healthcare includes three indicators: family health management, smart hospital management and regional health management, of which regional health management has the highest weighting at 0.856.

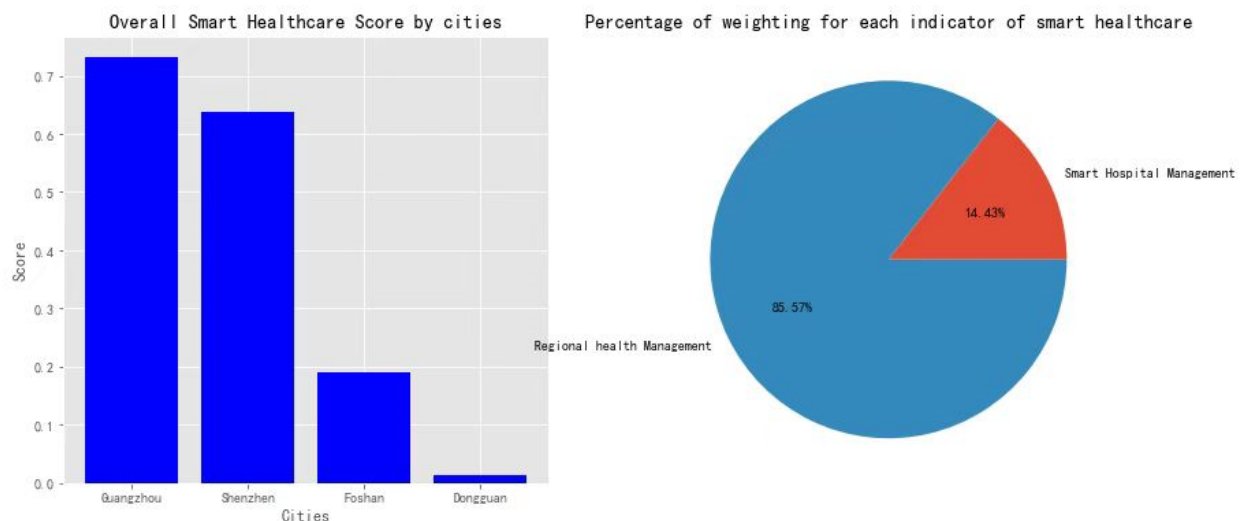


Figure 3-6. Overall score and weighting of indicators for smart healthcare by city

Regional health management demonstrates the relationship between hospitals, community health and individuals. Firstly, the rate of graded care (hospital and community health), according to the data from 2021, the downward triage rate is generally low, with the highest being only 1.29, which indicates that there is still a need to make the medical level of community health more accessible to the general public in order to divert people from hospital visits, mainly through peer-to peer support, where quality specialist resources are fed into the grassroots level through remote platforms, so that minor illnesses do not leave the county; free, regular Open tele-education for grassroots hospitals, including teleconferencing. With the support of smartphones and relevant departments for mobile healthcare, the online consultation rate is generally higher than 60%, and the online appointment rate in Shenzhen and Guangzhou has reached over 80%, which has greatly improved the efficiency of hospital consultation.

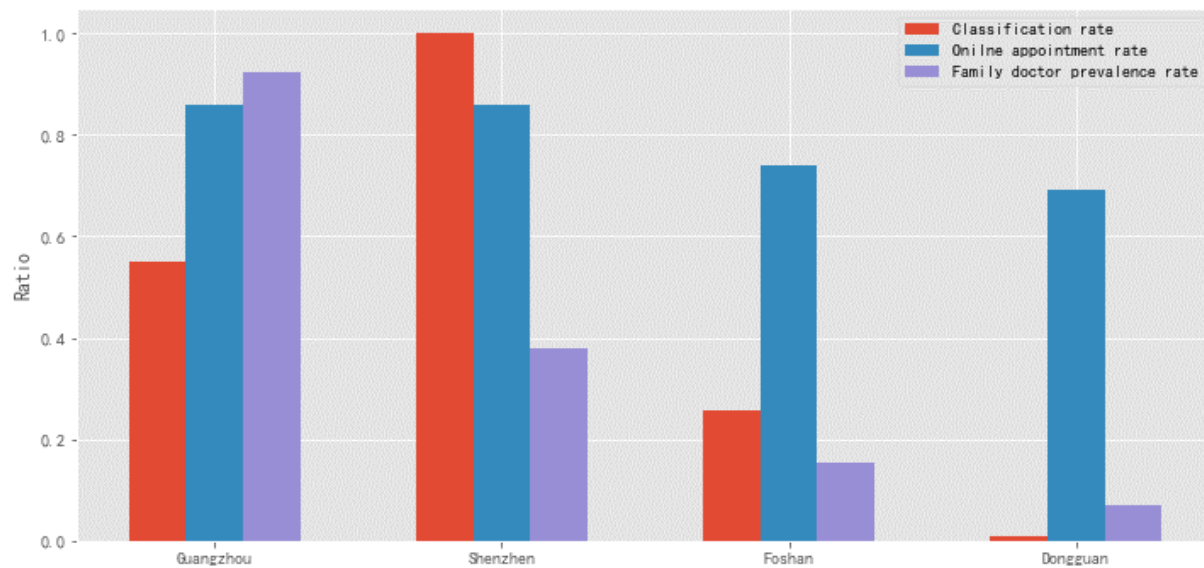


Figure 3-7. Regional health management indicators by city

For cities like Shenzhen and Guangzhou, where 5G systems are more developed, it is suggested that the allocation of resources in hospitals can be further optimised; and that the development of medical big data, including precision medical big data and public health big data, can be intensively promoted. For cities like Foshan and Dongguan, where information technology networks are yet to be developed, it is suggested that the continuous development of information and communication technology can be promoted first, and the convenience of online booking can be publicised. As there are still some differences in medical resources and medical standards across the region, it is suggested that interoperability of networks of medical institutions at all levels across the region can be promoted to enhance information sharing of regional medical resources. Finally, the prevalence of family doctors (community and individual) is low in Foshan and Dongguan. In practice, primary health care institutions are often constrained by environmental and financial constraints, and lack high quality and high level personnel, resulting in a low level of trust in primary health care services. In this regard, we suggest that excellent medical personnel should be trained in primary healthcare institutions, and that the talent pool of family doctor service teams should be strengthened to establish highly qualified and high-level family doctor service teams to meet the medical needs of contracted residents under the requirement of primary care.

CONCLUSION

Among the four cities, Guangzhou is a political city where the government has the majority of the power; Shenzhen is an economic city with a good economic base and more than enough funds for development; Foshan is an environmental city with a good environmental base and easier to deal with environmental problems; Dongguan is a development city, driven by the "Shenzhen-Dongguan" policy, and will build a smart city more quickly. Dongguan is a developmental city, driven by the "Shenzhen-Dongguan" policy, and will be able to build a smart city more quickly. A common similarity can be found in the four different city types: the government. Government policies and other actions will make inter-city construction more secure. Guangzhou needs to access new corridors and actively plan more hub layouts to improve the effectiveness of transport services. Shenzhen needs to co-ordinate multiple

departments and establish a long-term management mechanism for water and soil conservation that is managed by the whole industry. Foshan City can leverage its environmental advantages to develop an intelligent, digital and convenient cultural and tourism industry, and promote the construction and quality of tourism destinations. Dongguan is located in the geographical centre of the Greater Bay Area and can thus build a transport-oriented city to support a more compact space in the Bay Area and a composite rail hierarchy to meet the travel needs of the Greater Bay Area.

(i) Enhancing digital business infrastructure in the Guangdong-Hong Kong-Macao Greater Bay Area to help expand domestic demand and upgrade consumption

Urban ICT and various smart technologies provide a strong guarantee for the construction of smart city infrastructure and can enhance the operational effectiveness of the overall city system. Although China is continuously increasing its technological research and development efforts, there are still technical barriers that plague the construction of smart cities. Technologies for smart city construction include: ubiquitous computing, mobile communications, cloud computing, Internet of Things, big data, multi-network convergence, artificial intelligence, deep learning, data mining, knowledge management, etc. Breakthroughs in new generation information technology and intelligent applications have become bottlenecks in the development of smart cities, especially in the areas of big data analysis and management technology, intelligent computing technology, deep learning technology and other research needs to be in-depth and breakthrough, and the application of various technologies needs to be further expanded. Without the strong support of these technologies, it will be difficult to form intelligent decision support objectives in the connotation of smart cities. The first thing needed for technology development is talent. According to IBM's "Smart City Red Book" report, the current talent shortage in China's smart industry is more than 8 million people, and the shortage in the field of intelligence is more than 1 million people. To solve this problem, we must first increase investment in scientific research, actively promote the innovation strategy of talent-led technology, and play the role of innovative talent in the construction of smart cities and smart technology research. The Guangdong-Hong Kong-Macao Greater Bay Area has been at the forefront of business and technology innovation-driven development in the country, with a population of over 70 million, accounting for 5% of the country's total population, but generating around 12% of the country's GDP. An open, vibrant, innovative and diversified digital business infrastructure system will be the foundation for building an international first-class bay area and a world-class city cluster. There is a need to focus on fostering and building digital infrastructure including 5G, cloud computing, smart logistics, cross-border payments, etc., to strengthen the interactive resonance between digital infrastructure and industry, to promote import and export processing trade in the Guangdong-Hong Kong-Macao Greater Bay Area, and to meet the people's growing demand for consumer upgrading.

(ii) Building a 9+2 digital industry cluster for integrated development and shaping a digital-driven goose formation model

At present, there are five main modes of investment and financing and commercial operation of smart cities in China, namely: the government-independent mode; the government-enterprise shared mode; the government-investment-commissioned-enterprise construction and operation mode; the government-led construction, operation and transfer mode; and the enterprise-independent mode. At this stage, most of the investment and construction of China's

smart cities is mainly done by the government, with huge construction projects, limited government financial resources and no clear profit model yet, and enterprises and social capital are not willing to bear huge investment risks. Looking at the development of smart cities in various countries, developed countries have already gained relatively mature experience in building smart cities and have gradually formed a variety of smart city construction models. China's smart city construction needs to be based on the actual situation of each city, selectively learn from the successful experience of foreign countries, establish a multi-body investment, construction and operation constitutes a synergistic mechanism, clear responsibilities and rights, risks and interests of all parties, effectively reduce social transaction costs, the successful realization of smart city construction goals. In the early stage of construction, the government can give full play to its guiding role, establish a unified and effective leadership mechanism and inter-departmental coordination mechanism, and promote basic projects such as information infrastructure and public application platforms with large initial investment and strong public interest; in the middle and late stages of construction, it should actively encourage and attract social funds, broaden investment and financing channels, and establish a market-oriented and diversified mode of smart city construction and operation.

The Guangdong-Hong Kong-Macao Greater Bay Area has formed an industrial belt with Guangzhou, Shenzhen, Foshan, Dongguan and Zhaoqing as core nodes. The advantages of clusters in the three places have been highlighted, the complementarity of industries has been enhanced, and the industrial and value chains will continue to be upgraded. In the future, the Greater Bay Area will participate deeply in the global industrial division of labor and international competition through an outward-oriented economy, and through the digital reconfiguration of people and goods, the most direct connection will be made between the origin of goods and the target market to achieve lower inventory, lower costs and higher efficiency. It is necessary to vigorously develop core industries such as artificial intelligence and big data, take advantage of the core technologies of e-commerce platforms and big data, close the full linkage of new retail and new manufacturing through the intelligent backbone network, create industrial clusters with complete industrial categories, supply chains and distinctive division of labor, and constitute an industrial system with strategic emerging industries as the forerunner and advanced manufacturing and modern service industries as the mainstay through the digital transformation of enterprises. The city will also be able to form an industrial system through the digital transformation of enterprises, with strategic emerging industries as the forerunner, advanced manufacturing and modern service industries as the mainstay. To promote the construction of Ali Cloud Centre and Dharma Institute, cultivate a science and technology innovation corridor for the incubation of new industries, and provide talent and policy support for the transformation and upgrading of the digital economy.

(iii) Accelerating the construction of a smart Bay Area and promoting the intelligence of water resources, tourism, healthcare and transportation

Under the guidance of the "Smart+" policy, the country is establishing cross-sectoral and cross-regional business synergies, promoting the deep integration of information technology with residents' lives, and striving to provide comprehensive public social services, but many cities are still at the initial stage of investing human, financial and material resources in infrastructure development. Industry-wide and domain-specific applications of smart cities cannot be achieved overnight, and even the construction of specific industries will take a longer time. It is difficult for the public to see the results brought by smart cities in the short term, resulting in

low motivation and participation. The solution to this problem is: firstly, to describe the blueprint of the future smart city through diversified means of publicity; secondly, to prioritise the development of areas related to people's livelihoods and the pain points that people are most concerned about, such as smart healthcare, smart transport and smart government, so that people can actually feel the superiority brought by smart cities, fully mobilise the enthusiasm of all sectors of society, and get the support of a wide range of social forces; thirdly, to be driven by the role of demonstration Thirdly, driven by the demonstration role, the project will be further expanded according to the order of public needs and priorities, leading to extensive participation from all walks of life, reducing the risks and difficulties of construction, and achieving the purpose of steady progress and virtuous cycle.

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