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Evaluating Guangzhou's smart city development status: Multi-source data

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Abstract
Purpose: This study will build an extensive assessment index system that satisfies both the practical requirements and the theoretical framework for Guangzhou's smart city development. It will also conduct a thorough assessment of the development of 11 Guangzhou districts using data from multi-source data.
Design/methodology/approach: This paper summarises and compares the definitions and evaluation standards of smart cities in domestic and international studies, and constructs an index system for comprehensive evaluation of smart cities from six aspects: urban foundation, urban environment, urban transport, urban security, urban safety and urban vitality. The study makes comprehensive use of multi-source data such as text, webpage, statistics, etc., and constructs a standardised process for multi-source data.
Findings: The districts of Yuexiu, Liwan, Tianhe, and Baiyun, etc., districts closer to the municipal government, have higher comprehensive evaluation of their smart cities, indicating that government assistance is crucial to the development of smart city informationisation. Districts with a high degree of smart city development will have a serious imbalance in the degree of coordination of the development of its various parts. For example, Liwan District, whose overall level of development is the third in Guangzhou, has a serious imbalance in the degree of coordination of its coupling, mainly because of the low rating of its urban environment. There is a need to focus on the coordinated development of urban infrastructure, urban environment, urban transport, urban security, urban safety and urban vitality.
Research limitations/implications: There isn't one that is cohesive and thorough smart city evaluation system and method. In view of this, this paper will construct a thorough assessment index system that meets the theoretical system of Guangzhou's smart city development and the needs of real life. Based on multi-source data, it analyses the comprehensive evaluation and construction of 11 districts in Guangzhou.
Practical implications: Combining the actual project with the theory makes the Guangzhou smart city project's execution more scientific, and has warning and guiding significance for the Guangzhou smart city project's execution.
Originality/value: Combine the actual projects and theories to make the Guangzhou smart city project's execution more scientific.

Keywords: Guangzhou smart city; Multi-level indicator system; Big data; Coupling coordination degree

Introduction

City administrators are now faced with "urban diseases" like traffic congestion, difficult living conditions, and a lack of housing due to China's economic growth and ongoing urban population expansion. Simultaneously, the ongoing advancement of advanced technology offers a significant opportunity to enhance the methodical and scientific aspects of urban administration. (Loo B P Y&Wang B,1998).

In 2021, China's "Fourteenth Five Year Plan" noted that we should build an urban data resource system, encourage the development of an urban data brain, expedite the creation of smart cities, and support the innovation of governance models in both urban and rural areas through digitalization. In 2022, the "Fourteenth Five Year" Digital Economy Development Plan again emphasizes deepening the construction of a brand-new smart metropolis, promoting urban data integration and sharing and business collaboration, and improving the city's comprehensive management service capacity. At present, Chinese cities are at a new stage of the alternation of old and new governance models , The speed at which digital information technology is developing. 90% of Chinese cities are larger than prefectures regard the construction of new smart cities as an important starting point for cities to construct a fresh highland of development strategies. Smart city becomes an important path of urban governance modernization under the guidance in terms of a new development phase, concept, and development (Guan, 2022).

Driven by IBM, "smart city" has gradually become a policy choice and strategic planning for global urban development, attracting extensive attention from academia and society. Building a new smart city is a long-term, sustainable strategic objective. In the new development time frame of the "Fourteenth Five Year Plan", the traditional governance methods are challenged. The diversified scenarios of the smart city, including digital government, smart transportation and smart medical care, constantly call for new governance concepts and methods (Wen, Yu, Hong, & Chen, 2022). It is worth further studying how to accurately and comprehensively measure the state of smart city development, comprehensively and quantitatively analyze the strengths and weaknesses in the process of creating smart cities, and specifically complement the weaknesses when building smart cities, in order to improve the digital and intelligent governance capabilities of cities.

In October 2022, Guangzhou was regarded as the most innovative smart city in China from 2021-2022, and won the third place in the top 100 cities with comprehensive influence on the construction and development of new smart cities, with a 5A+rating. The development of urban smart cities is in the forefront of the country. Therefore, aiming at systematically summarizing the existing literature foundation of smart cities in this article, a smart city index system for evaluation including six dimensions of urban foundation, urban environment, urban traffic, urban security, urban safety and urban vitality has been constructed, and the six dimensions are set as six subsystems of Guangzhou's smart city development. Utilize big data crawler technologies to gather multi-source data, use entropy method to quantify the development level of smart cities in 11 districts of Guangzhou in 2021, and use Quantifying coordinated development by coupling coordination model relationship of six subsystems in all districts of Guangzhou, find out the weak subsystem of Guangzhou's smart city development, and propose targeted policy recommendations for the advancement of the smart city in Guangzhou, hoping to provide reference for other cities to quickly encourage the growth of smart cities in additional Chinese cities..

The following are some potential marginal contributions of this paper: (1) Combining big data crawling technology with the smart city measurement system, and using multidimensional data

analysis to construct a measuring system for smart cities that is more extensive; (2) Using the single case method, taking Guangzhou, China's smart city with rapid innovation and development, as an example, qualitatively and quantitatively analyze the development level, advantages and disadvantages of the smart city system. (3) The multi-dimensional data including geographic information data makes the analysis of smart city measurement and development direction outlook more comprehensive and practical, and can more intuitively reflect the short board and spatial distribution characteristics of smart city development.
The remaining research framework of this document is what it is: Section 2 is literature review. Section 3 introduces the research data sources and quantitative methods, including the creation of an index system for measurement and data processing instructions. Section 4 shows the main empirical analysis's findings. Section 5 summarizes the research conclusions of this paper and proposes targeted smart city development suggestions.

Literature Review

Concept Connotation Of Smart City

'Smart City' was initially put out by the Smart City Industry Technology Association in 1984. The smart city proposed by IBM in 2007 believes that smart city means more thorough perception, more comprehensive connectivity and more in-depth intelligence, and operates in a more intelligent way, hence improving city dwellers' quality of life and encouraging the peaceful and profitable development of the city (Wei & Li, 2019). Up to now, scholars and institutions both domestically and overseas have defined the notion of smart city based on different perspectives. With technological progress, the process of urbanization and economic development, the development concept of smart city is constantly updated (Teng, Si, & Liu, 2019). There's no agreement with the concept and connotation of the new smart city.
Some scholars focus on defining smart cities from the viewpoint of urban functions. Smart cities are based on modern technologies like s the Internet of Things and the Internet to promote the synergy of intelligent preservation of the environment, intelligent transportation, smart health care, astute government, smart energy and other functional elements, so as to improve urban governance and sustainable growth of urban economy, improve the quality of people's livelihood, and promote social equality (Li & Liu, 2011; Jiang, Jiang, Wang, & Wu, 2021). Smart cities have such urban development functions as convenient people benefiting services, accurate urban governance, transparent and effective online government, a creative and integrated information economy, and an autonomous and controlled safety system (Zang, Li, & Wei, 2018). Digital development endows smart cities with new characteristics of interconnection and sharing, efficiency and efficiency, lean and intensive, and humanistic happiness. Smart cities can realize the coordinated development of demand discovery, capacity sharing, and value inclusion (Yu, 2021). And smart city construction has talent siphon effect, knowledge diffusion effect and 'learning city' benchmarking effect, which can guide the green change of residents' lifestyle, optimize the urban environmental governance pattern, and encourage the urban economy's green development (Chu, Cheng, &Yu, 2021).
Some scholars accentuate the definition of smart cities from the standpoint of development models. As a new development model with an extensive level of information technology integration and urbanization, Building of smart cities is thought to be a key factor in the green technology innovation (Song, Li, & Li, 2021). Smart city is a process to promote urban construction, service, operation and management to become smart, and achieve high-quality green sustainable development under the constraints of resources and environment (Chang, Shi, & Zheng, 2022). A smart city is a high-end type of contemporary urban development and a new model for the harmonious development of urban economy, society, and environment. It

is a comprehensive urban development plan that integrates urban operation management, industrial development, public services, and administrative efficiency. (Ning, 2013), which is the best development model for the combination of informatization and new urbanization, and it is the integration of emerging industries and traditional industry drivers (Wang, 2021).
Other scholars tend to define smart cities from the standpoint of technological assistance. Smart cities, especially 5G new smart cities, should be aware of how 5G integrates with other technologies, such as cloud computing, big data, and the Internet of Things, so that a variety of modern digital technologies can be flexibly applied to end application scenarios, thus to achieve scientific urban growth Improved citizen life and effective administration are the foothold and to realize the city's intelligence (Song, 2018; Jia & Zhang, 2021). The term "smart city construction" describes the all-encompassing application of big data, cloud computing, artificial intelligence, blockchain, and other cutting-edge information technologies to the planning, building, management, services, and other areas of urban development in order to foster intelligent, efficient, equitable, peaceful, green, and sustainable development. (Margarita, 2014).Smart cities are mainly based on modern information and communication technologies. They need to use information technology to connect building infrastructure, IT infrastructure, living infrastructure and economic infrastructure (Harriso et al., 2010; Loo & Wang, 2017) . Smart City makes full application of technology for information and communication and network integration to manage urban activities as a whole ,and its essence is a network city with the Internet of Things as an important symbol (Sun & Zhang, 2022).

Smart City Evaluation Index System

Considering the connotation of the concept of smart city, both domestic and international research institutions and academics have successively presented a modular smart city evaluation system. Research institutions have researched the measurement system of smart cities relatively early. The international recognition of smart cities mainly includes the Intelligent Community Forum (ICF), IBM, the ranking of the world's top ten smart cities, and the EU smart city assessment index system. Domestic institutions have also explored the assessment index system of smart cities. As shown in Table 1.

Table 1: Comparison of Key Evaluation Points of Smart City Index System

Indicator	IBM	Vienna	EU	IESE	Chinese Standard	Chinese Academy of Sciences	Total
Government /Governance /Security	√	√	√	√	√	√	6
Transportation /Mobility		√	√	√	√	√	5
Infrastructure	√	√	√		√	√	5
Technology				√			1
Citizen /Manpower /Education	√	√	√	√			4

In terms of foreign institutions, ICF proposed to evaluate t he degree of development of smart communities from five dimensions, including internet access, knowledge-based employment, creativity, digital integration, public relations, and community marketing, providing a basis for the improvement and upgrading of subsequent evaluation indicators (Luo, 2017). IBM has created an index system for evaluating smart cities involving seven systems: urban services, citizens, commerce, transportation, communications, water and energy (Zhang, Xu, & Ming, 2019).

The Vienna system starts from the six dimensions of smart people, smart economy, smart governance, smart mobility, smart environment, and smart life, and then carries out standardized transformation and aggregation of the indicator system (Qin, 2015). The 2018 Global Smart City Report released by IESE Business School focuses on the evaluation and analysis of economy, human capital, social cohesion, environment, public management, government, urban planning, international influence, technology, mobile and transportation (Du, Huang, & Wang, 2020). And EU smart city research mainly evaluates and analyzes from six aspects: smart economy, smart travel, smart environment, smart citizens, smart life and smart governance (Caragliu, Bo, & Nijkamp, 2011).

In terms of domestic institutions, In 2016, the National Development and Reform Commission issued the New Smart City Evaluation Index, which includes eight indicators, namely, people friendly service, information resources, network security, intelligent infrastructure, ecological livability, reform and innovation, and citizen experience (Wang, Zhang, Wang, Cheng, & Liu, 2020). In 2018, the Report on China's Smart City Development Level proposed that the main elements of smart city evaluation should include smart infrastructure, smart governance, smart people's livelihood, smart economy, smart people and security system (Guo, 2021). The Chinese Academy of Sciences' Smart City Evaluation Indicator System 2.0 is broken down into six categories: smart city infrastructure, smart city economic development, smart city information services and public management and services, smart city science and humanities literacy, smart city citizens' subjective perception, and smart city soft environment construction. (Liu & Chen, 2021).

Some scholars also began to explore and improve the measurement system of smart cities. Yu Xiaobing and other smart economies, ecological environment, smart population, and smart public services and management build a smart city measurement system in Jiangsu Province (Yu, Lu, Xie , & Yang, 2017). Quyan and Wangqian build a smart city measurement system from five aspects: information infrastructure, economic development, scientific and technological support, industrial development and urban governance (Qu & Wang, 2018). Chen Yue and others built a smart city measurement system in Fujian Province from four aspects: urban economic strength, urban communication capacity, scientific and cultural environment, and smart city governance (Chen, Zheng, & Yang, 2019). Ma Jie et al. studied the modern smart city from the standpoint of multi-source data fusion of basic geographic information, government, enterprises and the public (Ma, Ge, Pu, & Zhang, 2019).

Methods

Construction Of Evaluation Index System

According to the definition and evaluation system of smart city in academic research, based on the principles of rationality, overall planning, practicality, and verifiability, this paper analyzes the six subsystems of urban foundation, urban environment, urban transportation, urban security, urban security, and urban vitality. Build a smart city assessment index system as shown in Table 2 .

Table 2: Comparison Of Key Evaluation Points of Smart City Index System

Level 1	Level 2	Level 3	Number	Weight
Urban base	Urban population	Actual population	C1	0.067
		Urban population density	C2	0.045
	Urban development	Regional development intensity	C3	0.004
		Urban building development intensity	C4	0.055
		Urban blue-green space ratio	C5	0.045
Urban environment	Urban meteorology	Wind speed	C6	0.005
		Precipitation	C7	0.006
		Temperature	C8	0.012
		Meteorological disaster warning signal	C9	0.030
	Urban ecology	Excellent rate of urban air quality	C10	0.012
		Urban water environment quality compliance rate	C11	0.063
		Resource and Environmental Efficiency	C12	0.034
		Ecological environment condition index EI	C13	0.041
Urban traffic	Urban passenger	flow Intra-city traffic passenger flow	C14	0.052
		External traffic passenger flow	C15	0.039
	Traffic efficiency	Road traffic index	C16	0.045
		Rail transit mileage	C17	0.061
		Highway/urban road mileage	C18	0.053
		Average motor vehicle speed during peak hours	C19	0.048
		Average one-way commute time for permanent residents of cities	C20	0.034
	Traffic planning	Urban road network density	C21	0.024
		Proportion of parking spaces in residential areas	C22	0.032
		Public transport motorized trip share rate	C23	0.062
		Urban greenway density	C24	0.025
Urban security	Basic water and electricity supply	City-wide water supply load	C25	0.018
		Natural gas supply load	C26	0.019
		The maximum gas supply capacity of the day	C27	0.023
		Total electricity load	C28	0.029
		The maximum power supply capacity of the day	C29	0.031
	Garbage treatment	Daily treatment of urban sewage	C30	0.022
		Centralized collection rate of urban domestic sewage	C31	0.023
		Urban domestic waste recycling rate	C32	0.012
		Amount of harmless disposal of domestic waste	C33	0.097

Level 1	Level 2	Level 3	Number	Weight
		Number of waste treatment transfer and terminal disposal facilities	C34	0.054
	City Elements	Number of City Parts	C35	0.051
		Urban park green space service radius coverage	C36	0.042
		Proportion of buildings in old urban districts	C37	0.035
		Share of green buildings in newly constructed structures	C38	0.027
		Complete community coverage	C39	0.021
	Housing income	Rental income ratio	C40	0.106
		Price-to-income ratio	C41	0.247
	Living environment	Inclusive kindergarten coverage	C42	0.050
		Community health service center outpatient sharing rate	C43	0.052
		Proportion of high-density hospitals	C44	0.067
		Sports area per capita	C45	0.045
		Proportion of high-rise residential buildings	C46	0.025
	Urban grid	Basic public service coverage of permanent population	C47	0.112
		The proportion of urban dwellers' minimum quality of living to their per capita consumption Expenditure of urban residents in the previous year	C48	0.093
		coverage of public areas' barrier-free amenities	C49	0.114
		Urban public toilet installation density	C50	0.093
		Census filing rate of various urban pipeline networks	C51	0.095
		Urban community grid management compliance rate	C52	0.113
Urban safety	Water safety	Urban perennial waterlogging point density	C53	0.093
		Distribution density of water accumulation points in residential quarters	C54	0.082
	Construction safety	Glass curtain wall fall risk	C55	0.062
		Deep foundation pit construction safety risk	C56	0.052
	Traffic safety	Urban fatality rate per 10,000 vehicles	C57	0.061
		Number of major construction accidents per 10,000 people in the city	C58	0.054

Level 1	Level 2	Level 3	Number	Weight
	Urban emergency	response capacity Urban per capita shelter area	C59	0.043
		Urban general hospital service radius coverage	C60	0.182
		Urban medical waste treatment capacity	C61	0.121
		Number and scale of large public facilities with emergency renovation conditions per million people in the city	C62	0.091
		Aggregation degree of urban traditional trade wholesale market	C63	0.078
Urban vitality	Major events	Major events	C64	0.166
	History and culture	Preservation and integrity rate of urban historical and cultural blocks	C65	0.052
		Average density of urban historic buildings	C66	0.118
		Integrity of urban traditional spatial pattern	C67	0.011
	Population vitality	Attractiveness of domestic and foreign tourists	C68	0.308
		Proportion of urban permanent resident population with household registration	C69	0.266
		Percentage of people who have completed college or higher education among urban residents who recently got jobs	C70	0.252
	Economic vitality	Non-public economic growth rate	C71	0.118
		The total amount spent on R&D in society as a proportion of GDP	C72	0.042
		high-tech businesses per 10,000 individuals	C73	0.138

Among them, urban foundation includes urban population and urban development, including 5 three-level indicators, which mainly reflect the situation of urban population and land development; urban environment focuses on comprehensive evaluation from urban meteorology and urban ecology, including 8 indicators , which mainly reflects the weather conditions of the city; urban traffic needs to be comprehensively evaluated from the aspects of urban passenger flow, traffic efficiency, and traffic planning, including 11 indicators, focusing on reflecting the city's internal rationality and external connectivity; urban security from the basic supply of water and electricity , garbage disposal, urban elements, housing income, living environment, urban grid, etc., including 28 indicators, focusing on reflecting the city's basic security, basic living resources and infrastructure construction; urban safety from water safety, construction safety, traffic Considering aspects such as safety and urban emergency response capability, it includes 11 indicators, which mainly reflect the safety of all aspects of the city; urban vitality includes 10 indicators in terms of

major activities, history and culture, population vitality, economic vitality, etc., mainly reflecting the city's economic performance. , Cultural attraction to people.
Based on the construction of the smart city evaluation index system, this paper collects and processes relevant data, and uses the entropy method to determine objective weights to comprehensively evaluate the development level of smart cities from six systems, and identify urban spaces at different levels according to the equal division method. Distribution characteristics, and comprehensively evaluate the development status of Guangzhou smart city. For a single urban space, the coordination degree of the development level of each subsystem is a key factor for the long-term development of a smart city. Thus, in order to better understand the coordination link between the urban subsystems, this paper employs the coupled coordination degree model, in order to identify urban types and discuss The construction of smart cities.

Multi-source Data Collection
The multi-level smart city evaluation index system proposed in this paper involves a wide range of content and requires multi-source data collection. The evaluation index system is constructed from 6 subsystems of urban foundation, urban environment, urban transportation, urban security, urban security and urban vitality, including 20 secondary indicators and 73 tertiary indicators, involving research institutions or enterprises reporting data, network monitoring Get data of types such as data, statistics, etc. As shown in Table 3
(1) Sort out and compare the analysis reports issued by domestic administrative departments, research institutions or authoritative websites, and screen and obtain relevant indicator data.
(2) The collection of web crawling data mainly relies on the method of batch retrieval of authoritative web pages, and manual verification and correction are carried out on this basis.
(3) The technology of batch retrieval of relevant APP information is used to collect data such as Internet and traffic popularity, express logistics timeliness index, etc.
(4) The collection of statistical data is mainly to sort out the authoritative statistical yearbook.

Table 3: The Sources of Data In This Paper

Data Type	Indicator	Data Source
Text report data	C3\C4\C5\C10\C11\C12\C13\C16\C17\C18\19\C20\C21\C22\C23\C24\C42\C43\C44\C45\C46\C47\48\C49\C50\C51\C52	"Guangzhou Urban Overall Planning Research Report", "Guangzhou Ecological Environmental Protection Work Summary", "Guangzhou Transportation Development White Paper", "China Guangzhou Urban Construction and Development Report", "Guangzhou Urban Grid Service" Management Measures", "Guangzhou City International Development Report"
Web scraped data	C1\C2\C6\C7\8\C9\C40\C41	"Census Data", "Digital Observation", "China Weather Network"
APP data retrieval	C14\C15	Railway 12306, smart ticket, bus steward, 12580 bus ticket

Data Type	Indicator	Data Source
Statistics	C25\C26\C27\C28\C29\C30\C31\C32\C33\C34\C35\C36\C37\C38\C39\C53\C54-C73	"2021 Waste Disposal Industry Report", "Guangzhou Housing Provident Fund" 2021 Annual Report, Guangzhou Practice Report on Resilient City Construction, China Urban Development Report, and 2021 China Urban Vitality Research Report

Data Processing Flow

The multi-source data processing process is mainly divided into heterogeneous data integration, data spatialization, data storage and other links as shown in Figure 1.

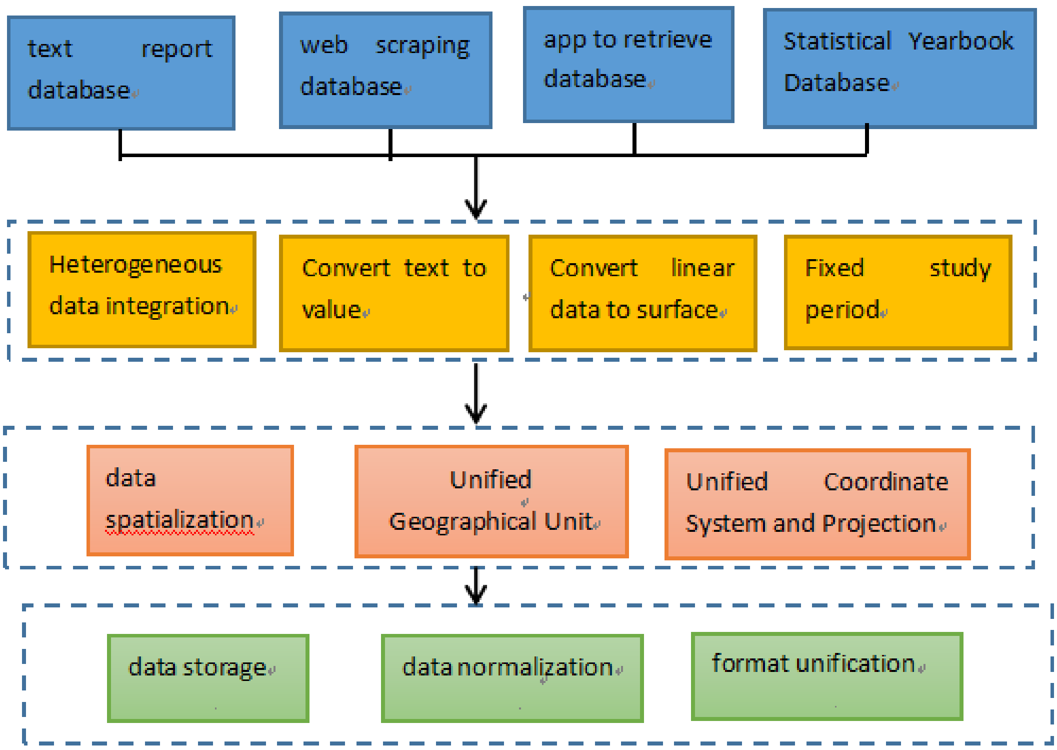

Figure 1: Multi-source For Smart City Development Status Evaluation

First of all, the first step in the integration of heterogeneous data is to determine a time node with high compatibility and timeliness according to the available data set. Based on this principle, the data year for this article is 2023. For the collected data, heterogeneous data integration includes converting text data in text reports into numerical values, and semantically identifying web search texts and converting them into data related to indicators. Next, spatializing the data requires determining a unified geographic unit, coordinate system, and projection to complete the process of vectorizing the data in ArcGIS. According to the theme of the evaluation indicators, this paper selects the prefecture-level administrative unit as a unified geographic unit to evaluate the development status of smart cities, and unifies the integrated data to the prefecture-level scale and conducts vectorization. Finally, multi-source data should be stored according to certain data standards and formats, and specific steps include dimensionless, scientific notation, etc.

Evaluation Method Of System Development Level-Entropy Method

The comprehensive system and subsystems of the smart city are the integrated expression of multiple indicators, and it is necessary to assess the development status of the system through comprehensive analysis.

Therefore, the weight of each index should be determined first. To stay away from the bias brought on by the subjective method of artificially determining the weight and the problem of information crossover between multiple index variables, This essay determines the objective weight using the entropy technique, which is based on th e index's variability. (Qin, 2015). Firstly, the extreme value method is used to carry out dimensionless and standardized processing of the data, and then the information entropy and utility value of each indicator are calculated respectively, and finally every indication has a weight that is determined on this basis. The main process is as follows:

(1) Firstly, the data is dimensionless and standardized by the extreme value method. In the process of entropy method, logarithmic operation is performed, and then the proportion of each index of the city is calculated;

(2) Secondly, Calculate the information entropy of each index. The greater the information entropy, the greater the difference of the index and the greater the impact on the result. Therefore, the utility value of the information is further calculated.

(3) Thirdly, Determine the weight of the indicators based on the information utility value of each indicator.

(4) Finally, the comprehensive weighting method is used to calculate the scores of each subsystem of the city, and the development level of the smart city comprehensive system is obtained by synthesizing the scores of each subsystem .

On this basis, according to the equal division method, the development stage of the smart city comprehensive system can be divided into five levels, namely extremely high level (50~60) , high level (40~50) , high level (30~40) , medium level (20~30) , lower level (10~20) and low level (0~ 10), the development of each subsystem is also divided into 5 levels by the same method, so as to facilitate a comprehensive assessment of the development of smart cities.

Evaluation Method Of Ssystem Ccoordination Relationship-Coupling Coordination Model

Urban foundation, urban environment, urban transportation, urban security, urban safety, and urban vitality are the foundations of smart city development. The coordination relationship between the six subsystems has a significant impact on smart cities' long-term growth.. Therefore, on the basis of the evaluation of the system development level, this paper uses the concept and model of capacity coupling in physics to construct a coupling degree model that reflects the evolution synchronization between systems. A coordination degree model is developed to better evaluate the relationship between the various subsystems of the smart city (Ma, Jin, & Liu, 2012). The main steps are:

(1) First of all, based on the evaluation of the system development level, the development scores of six subsystems, namely urban foundation, urban environment, urban transportation, urban security, urban safety, and urban vitality, are standardized, and then the coupling degree between the urban subsystems is calculated.

(2) Calculate the harmony index among the subsystems of the city, and calculate the coordination degree of the system development accordingly.

In order to facilitate the identification and analysis of the development status of smart cities, citing the studies of current scholars (Ma et al., 2012) , the coordination degree is separated into the following 4 types: when $D \leq 0.3$, it indicates that the subsystems belong to a low degree of coordination; when $0.3<D$ When ≤ 0.5, it indicates that it belongs to the moderate

coordination type; when 0.5<D≤0.8, it belongs to the high coordination type; when 0.8<D≤ 1, it belongs to the extremely coordinated type.

Findings

The Measuring Results Of Smart Cities

The measurement results are shown in Table 4. The comprehensive development level of smart cities in various districts in Guangzhou is uneven. Comparing various subsystems, the average level of urban safety is the lowest, followed by urban security and urban vitality; the average value of urban foundation and urban environment is significantly higher, and the overall development The level is relatively good, which also reflects that there is a certain difference in the degree of development among the six subsystems.

Table 4: The Measurement Results in This Paper

District	Overall Score	Urban Foundation	Urban Environment	Urban Transportation	Urban Safety	Urban Security	Urban Vitality
Yuexiu	39.38	8.21	6.31	8.53	6.89	5.23	4.21
Huangpu	37.8	6.42	8.56	4.21	4.18	6.34	8.09
Liwan	37.02	7.89	5.78	8.46	5.42	4.76	4.71
Tianhe	33.53	7.32	4.63	5.89	3.45	5.12	7.12
Baiyun	31.27	6.69	4.32	6.14	3.11	5.89	5.12
Haizhu	27.35	4.21	4.23	6.91	4.32	4.12	3.56
Panyu	23.69	3.34	4.23	4.78	3.61	3.21	4.52
Nansha	20.64	3.39	3.19	3.57	3.54	3.76	3.19
Zengcheng	19.87	3.19	3.7	2.89	3.16	3.75	3.18
Huadu	18.58	2.89	3.19	3.51	2.89	2.34	3.76
Conghua	17.56	3.12	4.34	2.12	2.45	3.45	2.08
Total	306.69	56.67	52.48	57.01	43.02	47.97	49.54

The Coupling And Coordination Results

The measurement results of coordination degree of subsystems are shown in Table 5 and Figure 2. Through the evaluation of the system coordination relationship, we can find out the coordination among the six subsystems of Guangzhou districts in urban foundation, urban environment, urban traffic, urban security, urban security, and urban vitality.

Table 5: The Measurement Results of Coordination Degree Of Subsystems In This Paper

District	Coupling degree C value	Coordination index T value	Coupling coordination degree D value	Coordination level	Coupling coordination degree
Yuexiu	0.89	0.57	0.71	8	Intermediate coordination
Huangpu	0.91	0.73	0.81	9	Well coordination

District	Coupling degree C value	Coordination index T value	Coupling coordination degree D value	Coordination level	Coupling coordination degree
Liwan	0.40	0.10	0.20	2	Severely disorder
Tianhe	0.87	0.17	0.38	4	Mild disorder
Baiyun	0.90	0.39	0.59	6	Barely coordination
Haizhu	0.66	0.19	0.36	4	Mild disorder
Panyu	0.89	0.27	0.49	5	Barely disorder
Nansha	0.94	0.77	0.85	9	Well coordination
Zengcheng	0.96	0.68	0.81	9	Well coordination
Huadu	0.84	0.52	0.66	7	Primary coordination
Conghua	0.41	0.11	0.21	3	Moderately disorder

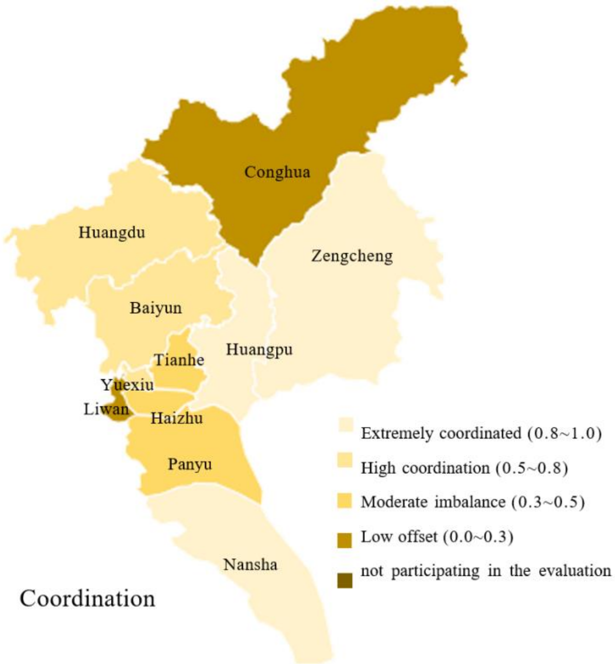

Figure 2: The Spatial Distribution of Coordination Degree Of Subsystems

The Spatial Distribution Of Coupling Coordination

The spatial distribution of subsystem coordination is shown in Figure 3(a) to Figure 3(g). It can be seen that most subsystems of Guangzhou Smart City develop in a relatively coordinated way. Urban vitality, urban security and urban safety have become weak links in the development of smart cities. Attention should be paid to the coordinated development of urban infrastructure, urban environment, urban traffic, urban safety, urban safety and urban vitality.

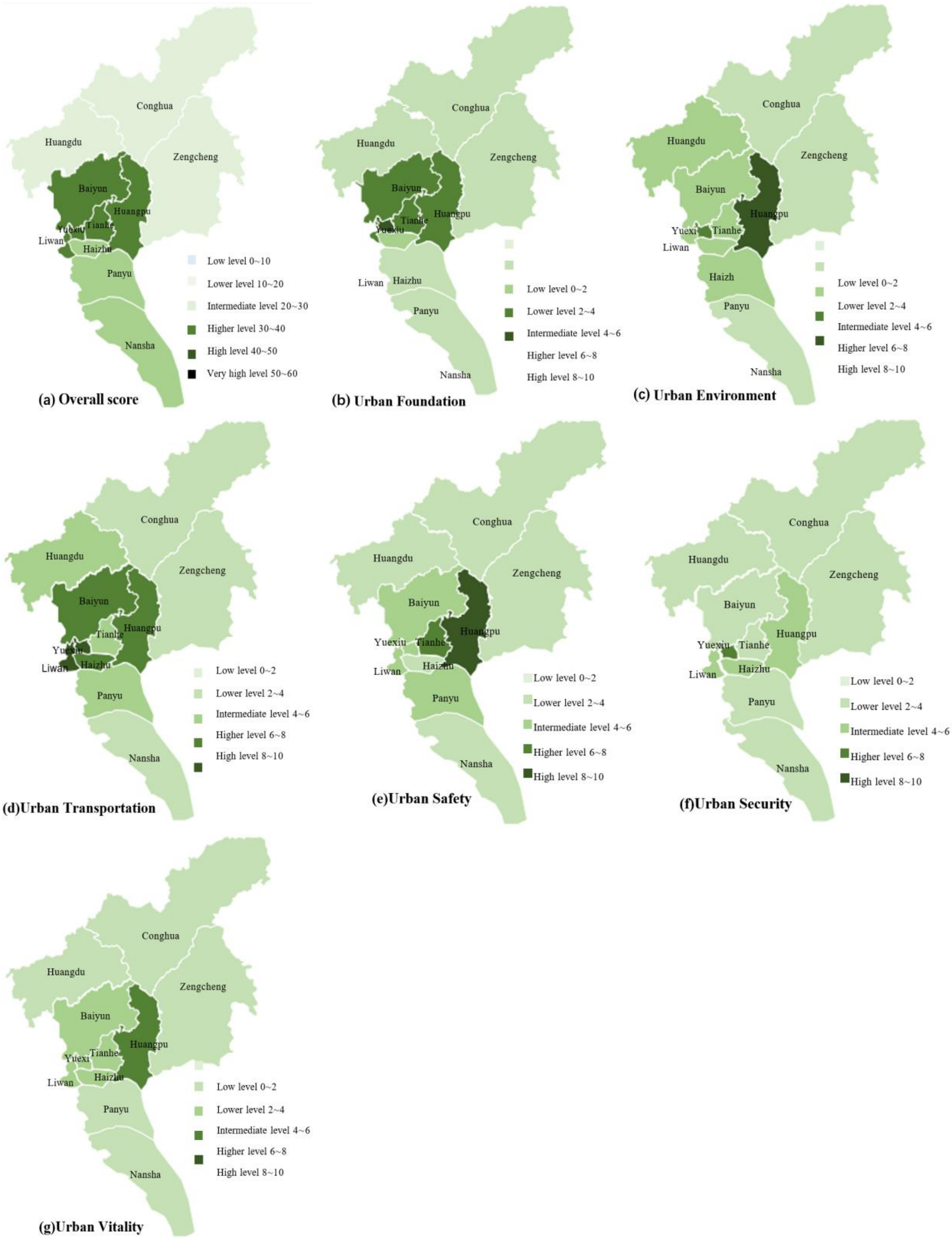

Figure 3: The Spatial Distribution Of Subsystem Coordination

Discussion and Conclusion

Smart city is an advanced stage of future urban construction, providing goals and means for urban development. However, there isn't yet a single, accepted definition of what constitutes a smart city.. Therefore, this paper summarizes and compares the definition and evaluation standards of smart cities both domestically and internationally, and constructs smart city from six aspects: urban foundation, urban environment, urban transportation, urban security, urban security, and urban vitality. An index system for comprehensive evaluation of cities. The

research comprehensively uses multi-source data such as text, web pages, statistics, etc., and builds a standardized processing process for multi-source data, which not only considers indicators reflecting scale and volume, but also focuses on indicators reflecting efficiency and fairness. Weighted analysis, coupling degree and coordination degree models are used to evaluate the development status of smart cities from multiple perspectives. According to the evaluation results of the development status of smart cities in Guangzhou, The primary conclusions drawn in this paper are as follows:
(1) In terms of overall score, the overall score of most urban smart city development did not exceed 30, and the level of smart city construction needs to be further improved. It indicates that government support has a significant impact on the development of smart city information;
(2) In terms of spatial distribution of urban scores, Districts of Baiyun, Tianhe, Huangpu, Yuexiu, and Liwan have relatively high comprehensive scores. The level of smart city construction in the urban center of Guangzhou is generally higher than that in the urban fringe;
(3) In terms of subsystem development and coordination, more than 54% of urban smart city subsystems develop in a relatively coordinated way. In areas with a high level of smart city development, the development coordination of all parts will be seriously unbalanced. The subsystem of urban traffic, urban infrastructure and urban environment scored higher. Urban vitality, urban security and urban safety have become weak links in the development of smart cities. Attention should be paid to the coordinated development of urban infrastructure, urban environment, urban traffic, urban safety, urban safety and urban vitality.

Theoretical Implications

In the process of multi-source data analysis, there are also various methods for mining interaction relationships. Integrating multiple methods such as association rule mining and factor analysis, the mining of interaction relationships will play an increasingly important role in various industries in the future.

Practical and Social Implications

Multi−source data analysis combines traditional static data and dynamic new data, which can help us more comprehensively and deeply explore the value of interaction relationships, effectively providing a powerful tool for comprehensively controlling the operation status of cities and diagnosing urban problems. It comprehensively reflects the operation status of urban sign systems and evaluates them.

Limitations and Suggestions for Future Research

According to the comprehensive evaluation of the current smart city development status, this paper suggests that the future development of Guangzhou smart city should optimize the top-level design by taking into account the current state of affairs as well as the unique features of each district's development., and provide urban foundation, urban environment, urban transportation, urban security, and urban security. , urban vitality and other aspects of policy support, and heed the coordinated development of different subsystems. The construction of a smart city should handle the relationship between the government and the market, and a smart city should be guided by the government and led by the market. In addition, smart cities are still in the ongoing process of research and development, and future urban development will inevitably generate new needs and characteristics, so this topic is still worthy of continuous attention and research.

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