Information Construction Level of Smart City

Jiani Hong
School of Shanghai University, Shanghai, China

*Corresponding author e-mail: 1530203900@qq.com

Abstract. With the development of China's smart city construction, the construction of smart city has set off an upsurge in various regions. However, because the construction of smart city is not yet mature, most of the cities have high similarity in construction and lack of individual characteristics. The key work of smart city construction is information construction, unifying the evaluation index system of smart city's information construction level, and selecting a scientific evaluation model. Type and method must be the core of the information construction of smart city. This paper introduces the relevant content of the information construction level of smart city and the background and significance of measurement research and constructs the measurement model of the information construction level of smart city. The author selects 13 smart cities as research samples, uses MATLAB statistical software to train and study the sample data and measures the information construction level of smart city. It is found that the information construction level of smart cities in developed areas is high.

Keywords: Smart City, Information Construction, Evaluating Indicator

1. Introduction
Due to the rapid economic and social progress and the vigorous advocacy of information construction, China's urbanization has gradually progressed to a new level. A round of deep cross-border integration of smart city construction can enable citizens to share information database, which can not only solve the congenital "information gap" between management and urban residents, but also improve the work efficiency and participation of managers the timeliness and grasp of favorable information. At the same time, data mining has increased the depth and breadth of information analysis, found more recessive favorable information; data-driven city has become an inevitable trend. With the continuous improvement of information construction of smart city (hereinafter referred to as "ICSC"), how to determine the key and difficult points of construction, unify the evaluation index system of construction level, and select the appropriate evaluation model and method called ICSC focus become more and more significant[1]. ICSC can promote the integrated development of information, urbanization and industrialization, and enhance the competitiveness and creativity of cities.

As early as the 1980s, Mr. Ni Huimin, the father of the global smart city, proposed the concept of "smart city". Graham and others first interpreted the smart city to ensure the next research work. After that, the research on smart city broke out on a large scale all over the world. In 1996, Graham elaborated the important position of the application of electronic information technology in the future...
development of the city in his works. For the first time, he proposed that the basic support of the future urban life must be the construction of information technology. Zheng, ran and others believe that SVS plays a more and more significant role in the service of smart city, and can effectively mine various potential and valuable information. George Cristian lazaroiu, put forward the evaluation model insightfully and evaluated the actual implementation results, discussed the key and core issues in the actual project work of construction, and constructed the concept model of smart city planning and construction. However, there are few researches on the measurement of information construction level of smart city[2, 3].

This paper attempts to construct the evaluation index system of the information construction level of smart city by combing the related theoretical knowledge of smart city and the evaluation of the information level of smart city and combining with the basic elements of the information construction of smart city. Under the background of the new era, smart city is actually the product of the combination of big data, cloud computing and the Internet of things, which poses a greater challenge to the information construction of the city[4]. The measuring position of the information construction level of smart city is increasingly prominent. Analyzing the core factors of the information construction of smart city is conducive to the construction parties and scholars to clarify their key work, and building a reasonable evaluation system is conducive to the development of the construction evaluation of smart city.

2. System Design

2.1. Construction Principles

Operability. The elements of the implementation layer in the evaluation system can be searched and calculated, and the indicator system is required to be easy to measure and collect. The quantitative indicators can be removed and standardized through a correct and reasonable scientific way, with clear and authentic official data sources.

Objective comparability. It means that ICSC level evaluation index system can fully consider the actual situation of construction, reduce the characteristics of human intervention, ensure the scientific accuracy of the index system, and enhance the authenticity and reality of the evaluation system.

System completeness. In theory, there should be appropriate relevance between the first and second level indicator systems, and the same level indicators can not cross and appear repeatedly. Secondly, there is a certain degree of connection between the indicators of each level of the evaluation system.

Adjustability. The evaluation system can't be completed in a single move. It needs to be constantly improved and enriched according to the continuous development of the later period and the established situation. This is a dynamic process of modification.

2.2. Design

It is necessary to determine the evaluation index according to the actual construction purpose of the evaluation of the information construction level of the smart city, so that the evaluation is practical and operable. First of all, on the basis of fully considering that the construction of the evaluation index system of the information construction level of smart city is affected by different dimensions, this paper follows the construction process of the evaluation index system, and evaluates the intelligent city or urban information construction from different dimensions according to the research status of the construction of the related index system of the information construction level of smart city. Based on the analysis of the basic construction of the level evaluation level of ICSC, starting from the basic elements of ICSC, this paper defines five first-class indicators as information infrastructure construction, public information service level, economic growth level, information environment and information industry[5].

The construction level of information infrastructure is the necessary prerequisite for the construction of smart city, the basic carrier for the planning, construction and operation management of smart city, and the premise and foundation for the construction and application of various fields of
smart city information construction[6]. According to the basic framework of urban information infrastructure construction, it mainly includes the perception layer and network layer of information infrastructure construction.

Public information service level is the basic responsibility of smart city service, and the starting point and supporting point of smart city information construction. Meanwhile, the continuous improvement of public information service level promotes the gradual completion of ICSC's important goal, and the unified platform for public information service of smart city is built according to all regions. Public information service covers the construction and application level of people's livelihood, government affairs and science and technology to measure the public service level of smart city.

The level of information industry is the basic, leading, policy and key industry of national economic and social development, which has a special supporting and guiding role in the continuous progress of economic society in a good direction. According to the national information report issued by the Ministry of Industry and Information Technology, the evaluation of information industry level can be divided into e-commerce development, financial industry information and modern industrial structure.

The level of economic growth is used to measure the level of economic strength growth of a region. It is the necessary guarantee and support of a large number of financial funds for the information construction of smart cities, and it needs to maintain a reasonable and sustainable level of economic growth. It has a great relationship with the efficient development of urban planning and construction and the improvement of people's living standards[7].

The level of information environment is a strong guarantee for the information construction of smart city. The comprehensive supervision and governance level of smart city lies in whether there are mature and operable sound policies, laws and regulations[8, 9]. On this basis, we should strengthen the government's macro coordination and regulation function, and actively formulate and implement various talent policy programs in the information field around the hot issues of the integration of smart cities and information security.

3. Model Construction

3.1. Construction and Analysis

GRA-BPNN learning algorithm is a combination of the advantages of GRA Method and BPNN algorithm, to avoid the inherent shortcomings of the two algorithms as much as possible. According to the basic process of BPNN evaluation, the evaluation algorithm of GRA-BPNN intelligent city information construction degree is established. Using the grey relation theory, the grey relation degree of each index is calculated to realize the reduction of the original index system, so as to eliminate redundant indexes. After eliminating redundant indexes, the remaining index set is input to BPNN as the value of input layer for learning and training.

3.2. Algorithm Flow

Step 1 Assumes that there are m evaluation items, n indicators for each item, y indicates the specific size of each indicator, and k is the evaluation indicator for a certain item.

Step 2 Calculation of grey correlation coefficient $r_{ij}$,

$$r_{ij} = \frac{\Delta \min + \rho \Delta \max}{\Delta_i(x_j) + \rho \Delta \max}$$  \hspace{1cm} (1)

Step 3 Assume that the grey correlation degree is $\sigma_i$,

$$\sigma_i = \frac{1}{n} \sum_{j=1}^{n} r_{ij}$$  \hspace{1cm} (2)
Step 4 After normalization, a neural network is created. The number of input layer $M = m$, that is, the number of condition attributes filtered by the gray correlation degree. This paper measures the information construction level of smart city. The output layer node represents the information construction level of smart city, and the number of neurons is $m = 1$.

Step 5 Initialize the learning parameters and calculate the output value of each layer. The training output is compared with the model prediction output. If there is any error, the weight and threshold value are modified after reverse propagation.

### 3.3. Empirical Research

This paper selects 13 cities of Beijing, Tianjin, Shanghai, Chongqing, Nanjing, Shenzhen, Guangzhou, Xiamen, Wuhan, Hangzhou, Ningbo, Chengdu and Qingdao as samples, which are represented by u1-u13. Collect the attribute values, sort out the original data of the measurement of the level of information construction of smart city. The input sample data of BP neural network is the city with serial number 1-8, the normalized data of 44 indicators, and the output sample data is the information index of the city with serial number 1-8, the normalized data is: $D_1 = 0.73$, $D_2 = 0.25$, $D_3 = 0.60$, $D_4 = 0.54$, $D_5 = 0.49$, $D_6 = 1.00$, $D_7 = 0.74$, $D_8 = 0.47$. The test sample selects the number obtained from the dimensionless processing of 44 indicators included in city serial numbers 9 to 13 Value. In this paper, the output training results of the BPNN system constructed by different hidden layer numbers are shown in Table 1.

**Table 1.** Training results of neural network system constructed by different number of hidden layers.

| Number of hidden layer nodes | Iteration times | Training gradient | Best performance |
|------------------------------|-----------------|-------------------|-----------------|
| 6                            | 4               | 0.0781            | 0.08734         |
| 7                            | 6               | 0.0668            | 11.3619         |
| 8                            | 3               | 0.23256           | 0.0025452       |
| 9                            | 4               | 0.589             | 14.1126         |
| 10                           | 5               | 3.48              | 0.01834         |
| 11                           | 9               | 0.792             | 0.223865        |
| 12                           | 21              | 0.743             | 32.736111       |
| 13                           | 11              | 5.32              | 14.8153         |
| 14                           | 6               | 4.727             | 0.09732         |
| 15                           | 17              | 0.419             | 4.447291        |

After 4 iterations of training sample value and test sample value, the training performance reached the best at the third time, the best performance was 0.0025452. The training result and the expected result of BPNN model are very close to each other. The error between the training result and the expected result reaches the preset goal. When the number of training reaches 4, the descent gradient is 0.23256. During the training, the descent gradient changes rapidly, iterating for 4 times, and the gradient drops from 1.2 to 0.23256, reducing by 80.62%. At this time, the variable is 0.01 lower than the target error, so the training fails in the next step, that is, the minimum error has been found. At this time, the generalization ability check reaches the threshold value, and the training is forced to end in step 4.

After BP network training and learning, we got the measurement model of information construction level of smart city. Based on the model and existing data, we predicted and tested the information construction level of 13 smart cities selected in this paper, and compared the prediction value of cities with sample No. 9-13 with the information evaluation value of smart cities in 2016 China urban information index development level evaluation report. It is found that BPNN model has a good effect on the urban evaluation of sample No. 9-12, with the minimum error of 1.82% and the maximum error of 4.44%. In general, the prediction trend of this model is consistent with the actual situation, and the accuracy rate is reliable. The results show that the information construction level of 13 cities roughly conforms to the prediction curve. The information construction level of Beijing, Shanghai, Shenzhen,
Guangzhou and other cities is relatively high. In view of the information infrastructure construction of these super-tier cities is relatively perfect and the economy is developing. At the same time, the government has played an active role in regulation and control, constantly innovating new industries and developing information industry, so the level and quality of information construction of smart city is high. However, although the economic development level of Chongqing, Chengdu, Xiamen, Wuhan, Qingdao and other central regions has improved in recent years, the government's policies on strengthening the information environment have been implemented in a small way, the problems of confidence and security have occurred frequently, and the flow of information talents has also spread to the coastal and other first-tier cities. The construction of the city's public information service platform is not timely, so the level of public information service is low. The information infrastructure of the city is in the initial stage of information infrastructure construction, so the level of information construction of smart city is relatively low.

4. Conclusion
According to the measurement results of the information construction level of smart city, it shows that the information society development level between the two regions in the East and the middle of China is quite different, and the information society development level gap between these regions is still increasing. The information construction level of smart city is distributed in an ellipse as a whole, and the cities with higher and lower construction level are relatively few, and the level of most cities is relatively close. At this stage, the overall level of urban intelligence in China is not enough. The intelligent construction in various fields is still in urgent need of further strengthening. The author puts forward the following suggestions. We will improve the information infrastructure of smart cities, constantly improve the information environment, adjust the industrial system and improve public information services[10].

Acknowledgment
Thanks to the teachers and classmates who helped me during my thesis writing, I have a good living environment and a positive learning atmosphere. At the same time, you have put forward a lot of valuable suggestions with great enthusiasm for the revision of the paper, which makes my paper more perfect.

References
[1] Simon Elias Bibri. On the sustainability of smart and smarter cities in the era of big data: an interdisciplinary and transdisciplinary literature review[J]. Journal of Big Data,2019,6(1).
[2] Imad Jawhar,Nader Mohamed,Jameela Al-Jaroodi. Networking architectures and protocols for smart city systems[J]. Journal of Internet Services and Applications,2018,9(1).
[3] Karpenko Anastasiaa,Kinnunen Tuomas,Madhikermi Manik,Robert Jeremy,Främling Kary,Dave Bhargav,Nurminen Antti. Data Exchange Interoperability in IoT Ecosystem for Smart Parking and EV Charging.[J]. Sensors (Basel, Switzerland),2018,18(12).
[4] Steve Mitnick. Cities Getting Smarter[J], Public Utilities Fortnightly,2018,156(10).
[5] Ian Young. EPCA 2018: Focus on smart cities[J]. Chemical Week,2018,180(23).
[6] Angela Gismondi. CanaData panel discusses smart city opportunities, challenges[J]. Daily Commercial News,2018,91(206).
[7] Chris Barker. Mobility Meets Sustainability: Smart City Tech into North America's Transit Systems[J]. Mass Transit,2018,44(8).
[8] Merlin Stone,Jonathan Knapper,Geraint Evans,Eleni Aravopoulou. Information management in the smart city[J]. The Bottom Line,2018,31(3/4).
[9] Granda Fausto,Azpilicueta Leyre,Vargas-Rosales Cesar,Celaya-Echarri Mikel,Lopez-Iturri Peio,Aguirre Erik,Astrain Jose Javier,Medrano Pablo,Villandangos Jesus,Falcone Francisco. Deterministic Propagation Modeling for Intelligent Vehicle Communication in Smart Cities,[J]. Sensors (Basel, Switzerland),2018,18(7).
[10] Tobias Brandt, Wolf Ketter, Lutz M. Kolbe, Dirk Neumann, Richard T. Watson. Smart Cities and Digitized Urban Management [J]. Business & Information Systems Engineering, 2018, 60(3).