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# GLOBAL SMART CITIES 2020

HUMANITY, TECHNOLOGY AND SUSTAINABILITY

## 全球智慧之都报告 (2020版)

人本·科技·可持续



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# EXECUTIVE SUMMARY

**"Global Smart City 2020" is the fourth edition of biennial review of smart cities released by the Smart City research group of Shanghai Academy of Social Sciences since 2010.** This report is the result of cooperation with Smart City Research Center of School of Management, Fudan University under the background that the coronavirus epidemic is still spreading. Especially, we are grateful to have the consistent support from the United Nations Public Administration Network.

This report builds a "5+1" evaluation model for global smart cities, and provides five quantitative indicators, namely smart infrastructure, smart economy, smart services, smart governance, and smart innovation, plus one qualitative indicator "smart reputation", a total of six dimensions of comparison, attempts to set a benchmark for global smart cities, and provides diversified solutions for the realization of the Sustainable Development Goals 2030 (SDG 2030) proposed by the United Nations in 2015 as well.

Through continuous follow-up research of the practices of the "Smart cities" in the past ten years, we find that the fundamental challenges of the city are typically not solved by technology itself, but more by the governance of the city. At the same time, the introduction of technology often requires complementary policies. Only when the policies changes are aligned can the best performances be achieved. In other words, only by truly achieving people-oriented and mobilizing all stakeholders involving government, business, and communities, civic society to participate in all aspects of the city can we get a smarter city.

This report reflects the themes of "Humanity, Technology and Sustainability":

The first is to highlight the spirit of "humanity", i.e., the citizen-centered approach, which reflects in the indicator of "smart service";

The second is to emphasize the impact of emerging digital technology on urban governance, including the increasingly important agenda of "data governance". Therefore, we introduce the indicator of "smart governance";

The third is to strengthen the role of innovation in the development of smart

cities, especially in sustainable development, and propose that the sustainability of smart cities is inseparable from innovation enabled by digital technology, thereby introducing the "smart innovation" indicator.

The first part of this report is the comprehensive ranking. The results show that global smart cities can be divided into three levels: "leading", "advanced" and "following". London, New York and Singapore are in the leading position and the star cities in this ranking. They have maintained a leading position in almost every aspect of smart cities and have become role models for other cities around the world.

**The second part analyses the sub-index rankings.**

With regard to **smart infrastructure**, Hong Kong and Singapore rank in the top two. Some cities in Europe and America followed closely behind. Among developing cities, Dubai has a relatively outstanding performance.

In terms of **smart economy** sub-index, New York and London ranked the top two. Beijing and Shanghai have performed well in this field and entered the first camp.

The **smart service** sub-index reflects the smartness of city's citizens' livelihood services. Shanghai and Beijing have performed very well, indicating that China's major cities are already at the forefront of the world in terms of digital technology applications. Dubai and Singapore ranked second.

In terms of **smart governance** sub-index, London and Seoul rank the top two. They excel in the dimensions of data openness and sustainability. Dubai and Singapore ranked third and fourth respectively.

In terms of **smart innovation** sub-index, traditional world cities such as London, New York, Paris and Tokyo rank top four. They have outstanding performance in science and technology, education, innovation, and have stronger human capital as well.

**"Smart reputation"** reflects the degree of attention in academy of major smart cities. The results show that Beijing, Singapore and New York rank in the top three, and their smart city construction is favored by academic circle.

## Preface

After the concept of "Smart Earth" was proposed in 2008, the concept of "Smart City" was also put forward, which has been 12 years till now. In the past 12 years, our city has experienced waves of new technologies including the Internet of Things, big data, cloud computing, artificial intelligence, and block chain. Our city also experienced several waves of urban intelligence. We are delighted to see that smart cities have evolved from an original industrial imagination and cutting-edge topic to a topic that is shared by all cities on a global scale regardless of country, religion, race, and economic development level. The smart cities also play an increasingly indispensable role in urban planning and digital economy. At the same time, we are also concerned about the global criticism and doubts about smart cities. As followers and researchers in the field of smart cities, we can't help but re-examine and question what is a smart city and what is the true power and value that "wisdom" should give to the city.

For this reason, we have studied a large number of recent cases of urban smartness and almost all mainstream smart city evaluation systems and ranking results in the world. At the same time, we also studied critical research and reports on smart cities from political science, sociology, anthropology, economics, management aspect, and from the fields of rationalism, restrictionism, and reflectionism. These views cross and collide with each other and even contradict each other. But from this we can still find the biggest consensus, that is, smart city has truly become a comprehensive proposition centered on people, multi-element, multi-subject, and multi-disciplinary integration. Behind it is the decline of the technology-driven theory that was once the source of smart cities. At the same time, in

addition to ICT technology and infrastructure, perspectives from management, society, and humanities are gradually moving toward the center of the arena of urban intelligence. More and more cities are beginning to truly realize that smart cities are not simply urban informatization, but a continuous evolutionary process of urban intelligence. Its ultimate goal and construction elements should be unified with each other, that is, more servings for residents in multiple places, better connecting industries, deepening innovation, and greater efforts to develop human capital and broader social participation. These intangible elements have increasingly replaced the central position of the original tangible elements. At the same time, supported and empowered by these tangible elements, they have become a new fulcrum for cities to continuously improve their overall strength and satisfy residents' pursuit of a better life.

Finally, I would like to thank the Shanghai Academy of Social Sciences Information Research Institute and our colleagues and students from the Smart City Research Center of the School of Management of Fudan University for their contributions to this report. We also sincerely welcome friends from all over the world who are interested in the process of urban intelligence to study and discuss together.



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# 1. Overall ranking

## 1.1 Introduction

In 2008, the global urban population just crossed the threshold of 50% threshold of the global population, marking the century arrival of a when the world entered the city eracentury. By 2018, the global urbanization rate reached 55.3%, an increase of 5 percentage points in 10 years. The world's dependence on cities is increasing, and the well-being of more than half of humankind rests on the wisdom of cities create for more than half of human well-being. Cities can indeed make life better.

With the continuous development of digital technology today, most cities in the world have invested a large amount of resources in the construction of smart cities. However, due to the different core concepts of smart cities, they determine the differences in the direction of technology application and implementation effects. Some cities take it as an opportunity to change the way of urban governance, others stay at the technical level of partial transformation, and some cities just use it as a slogan.

The new wave of scientific and technological revolution has given "smart cities" richer connotations. Information technologies such as artificial intelligence, big data, block chain, and industrial Internet have fundamentally changed the way businesses operate, people's lives, and public management, making the "smart" side of the "smart city" more distinct and more vivid, which close to the lives of citizens.

However, smart cities cannot simply be used as a new generation of information technology in cities, or turn the city into a "panoramic" monitored object. After all, cities are composed of people, and technology needs to be people-oriented. People of insight in smart city theory and practice have repeatedly reminded that the construction of smart cities should not fall into the quagmire trap of "Technocracy" (Hill, 2013).

So far, the practice of smart cities in various countries has been in practice for more than ten years. It has gradually changed from the earliest concept of information technology as the core to focusing on people-oriented and sustainable. Searching for the keyword "smart city/cities" through the Internet search engine can obtain relevant high-frequency vocabulary including: ICT infrastructure, people's quality of life, sustainable, green growth, public participation, digital divide, etc.

In recent years, some literature reviews have found that there is still a lack of a universally accepted definition of what is meant by a “smart city”. Differences exist in the different perspectives of the theoretical and practical circles, technological and social orientation, confusion of terminology and many other aspects (Cocchia, 2014; Mora, Deakin & Bolici, 2017; Maček, Ovin, & Starc–Peceny, 2019), which shows that smart city as a discipline is still evolving and has not formed a mature research paradigm.

Nevertheless, from the existing research, we can still find that there are several core dimensions in the understanding of smart cities in different aspects:

**the technical dimension:** Smart cities are based on the use of infrastructure (especially ICT) to improve and change life and work in cities in related ways. This dimension can include the connotations of different terms such as “digital city”, “information city”, “wireless city”, “ubiquitous city” and “smart city”.

**the human dimension:** Talent, education, learning and knowledge are the soul of a smart city and the key driving force of a smart city. This dimension can be connected with concepts such as “learning city”, “science and innovation city” and “knowledge city”.

**the governance dimension:** The cooperation and participation between city stakeholders and the government is very important for the design and implementation of smart city plans. This dimension is closely related to the concepts of “smart community”, “sustainable city” and “green city”.

**the industrial dimension:** The prosperity of the city originated from the advantages of scale effect. The gathering of a large number of people and various enterprises made it possible to allocate the cost of infrastructure and large-scale production, promoted economic prosperity, and constituted the foundation of urban operation. Citizens need decent jobs to earn income, and the funds needed for urban governance and public infrastructure construction need to be taxed. The development of industries and their clusters is the most important part of the realization of smart cities.

Based on these dimensions, this subject attempts to propose an indicator framework for the horizontally comparable and sustainable development of global smart cities. Under this framework, cities of different countries, different cultures, and systems can be compared horizontally, so as to provide readers with a broad perspective on the frontier of global smart city development, and provide a benchmark for smart city construction.

## 1.2 Review of Existing City Ranking

There are currently multiple rankings of global cities, with different research institutions ranging from wisdom, dynamics and vitality, scientific innovation, livability and sustainability.

The IMD World Competitiveness Center "Smart City Index" (Smart City Index) is based on the United Nations Human Development Index (Human Development Index), dividing cities into four groups, from two pillars of structure and technology, and five secondary indicators (health and safety), travel, activities, opportunities, and governance) to conduct a perceptual assessment of urban intelligence. This indicator system conducts intra-group comparisons, mainly subjective indicators.

The "Cities in Motion Index" (Cities in Motion Index) of the IESE Business School of the University of Navarra in Spain uses human capital, social solidarity, economy, governance, environment, transportation, urban planning, international connectivity and technology and other indicators with 95 in totals to rank 174 cities. This index system is a very large indicator system, involving all aspects of the city.

The "Global Power City Index" proposed by the Mori Memorial Foundation of Japan focuses on six aspects of cities: economy, technology research and development, cultural interaction, livability, environment and accessibility, with a total of 70 indicators. They ranked 48 major cities. This index does not directly reflect the city's development in digital technology.

Since 2010, this research group has been tracking the research and development of global smart cities (Smart City Dictionary, Smart City Review, Global Smart City Ranking 2014, 2015, 2017). The previous "Global Smart City" rankings mainly focused on three aspects: smart infrastructure, smart economy and smart governance. This system is relatively simple, and in the early stage of smart city development, it can effectively distinguish the smartness of global cities. But to a certain extent, this is a digital technology-centric system, that is, under the empowerment of digital technology, it reflects the development of urban economy, public services and governance.



In light of the changes of the times, this research group intends to further divide the promotion practices of major cities into five categories:

**related to digital infrastructure construction**, including various digital strategic plans;

**related to digital industry support policies**, which encouraging enterprises to use digital technology to achieve digital transformation;

**smart city governance policies**, including public data openness, citizen data security, and sustainable policies;

**the application of digital technology in the field of public services**, mainly services related to people's livelihood, including policies in education, medical care, and employment;

**policies on technological innovation and entrepreneurship**, that is, the efforts made by cities in creating a good environment for innovation and entrepreneurship.

Obviously, compared with the original smart city concept, the guiding ideology of the new generation of smart cities has undergone important changes. It is necessary to further enrich the original indicator system, which is reflected in:

**the new smart city should be more people-oriented.**

A city is a whole composed of people, and the goal of technology application is for people's well-being. Therefore, the evaluation of smart cities must first reflect the subjectivity of people and the quality of services to residents, so it is necessary to increase indicators reflecting the level of public services.

**the rapid development of digital technology.**

Its connotation is constantly changing. For example, mobile phones have been upgraded from 3G to 4G and 5G; while mobile Internet and Internet of Things in big cities have become ubiquitous. Wearable smart devices make people's lives smarter. Such indicators need to be updated continuously.

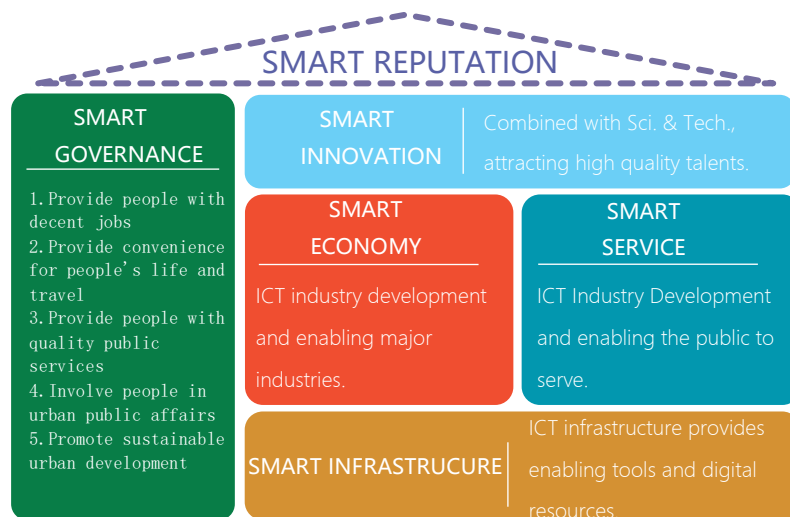
**digital technology has had a huge impact on urban operations and traditional industries.**

Major cities attach great importance to the impact of data and digital technology on innovation, which depends on the ability of education, technology research and development, innovation and entrepreneurship, so it is necessary to increase indicators reflecting the level of technological innovation.

Based on this, our research group summarized it as a

**"5+1" framework for global smart city construction.**

The construction of a smart city will form a number of "products or services" based on digital technology: digital public services, digital-enabled innovation capabilities, digital life quality, and digital ecological environment, which will ultimately be reflected in the city's digital brand and reputation.



**"5+1" framework for global smart city construction**

### 1.3 The Measurement Methods of Smart City

Based on the global smart city theoretical framework, our research group measures and evaluates smart cities from the above five aspects, and further decomposes its three-level indicators, weights and data sources as shown in the following table.

Theoretical measurement index system for global smart cities				
Smart Infrastructure				
Mobile phone	Next-generation network	Export bandwidth	Data center	
25%	25%	25%	25%	
Smart Service				
Online medical	Convenient transportation	Online education	Online employment	
25%	25%	25%	25%	
Smart Economy				
Interactive design	Software development	Digital application	Letter capacity level	
25%	25%	25%	25%	
Smart Innovation				
University strength	Research and development	Innovation and entrepreneurship	Human skills	
25%	25%	25%	25%	
Smart Governance				
Data open	Public safety	Sustainability	Public participation	Social inclusion
20%	20%	20%	20%	20%
Smart Reputation				

The theoretical framework, evaluation dimensions, three-level indicators and weight chart of this project



## 1.4 Overall Ranking and Analysis

The research group selected the data of 20 cities around the world for ranking. After the data was dimensionless and converted into a percentile system, the results were obtained in the following table. It is worth noting that the scores here are only relative terms, each index ranks first, that is, 100 points are assigned.

Level	City	Smart infrastructure	Smart economy	Smart Service	Smart governance	Smart innovation	General comment	Rank
Leading	London	89.9	81.7	77.9	74.3	89.4	100.0	1
	New York	87.9	89.6	74.7	68.8	86.7	98.7	2
	Singapore	96.4	72.3	85.8	70.4	79.5	97.9	3
Advanced	Shanghai	71.7	79.1	96.3	69.0	69.1	93.2	4
	Beijing	72.8	79.9	92.0	67.0	71.5	92.8	5
	Paris	81.3	72.6	77.0	65.9	82.1	91.7	6
	Hong Kong	96.5	65.0	75.1	62.5	77.5	91.1	7
	Los Angeles	87.9	69.5	65.5	63.7	80.7	88.9	8
	Chicago	87.9	69.9	68.8	63.6	75.7	88.5	9
	Seoul	78.4	58.9	75.0	72.9	79.7	88.3	10
	Dubai	85.0	59.7	88.8	71.3	59.8	88.2	11
	Tokyo	78.7	66.6	67.9	62.9	82.0	86.6	12
	Sydney	83.7	60.4	68.4	68.0	73.4	85.6	13
	Toronto	82.5	64.9	66.1	69.1	66.9	84.6	14
Following	Berlin	84.1	58.7	62.4	67.5	68.3	82.5	15
	Moscow	71.9	56.7	78.8	62.1	66.7	81.3	16
	Mumbai	65.1	46.8	70.2	62.8	48.3	70.9	17
	Buenos	73.1	40.0	54.2	51.7	53.1	65.9	18
	Ellis	70.6	36.5	39.7	47.3	48.4	58.7	19
	Rio de Janeiro	53.8	29.4	58.4	46.2	39.2	54.9	20

According to the score, the wisdom of 20 cities is divided into three levels based on plus or minus 1 standard deviation of the average value.

**The first level (above 96.1 points)** is called a "leading" smart city, including the top three: London, New York and Singapore. They maintain a leading position in almost every aspect of smart cities and become role models for other cities around the world.

**The second level (72.9-96.1 points)**, called the "advanced" smart city, includes 13 cities, which are advanced in various indicators, with outstanding performance in individual indicators.

**The third level (72.9 points or less)**, called "following" smart city, which has four cities. In terms of other global smart cities, these cities are not particularly prominent and are in the position of followers.

## 2. Sub index ranking

### 2.1 Smart infrastructure

The vigorous development of smart infrastructure has greatly changed the world. Compared with the previous generation of information infrastructure, the most important feature of smart infrastructure is to highlight the word "wisdom". IBM divides it into a combination of three aspects: digital, interconnected and intelligent. But this is still largely the intelligence of machinery and equipment. With the revival of artificial intelligence, the capabilities of smart infrastructure are not limited to this, but have the ability to surpass humans in different professional fields, and man-machine symbiosis will become normal in the future.

Smart cities are built on smart infrastructure, and their content mainly includes the growth and popularization of broadband (fixed and mobile), new-generation mobile communication services, computers and various smart terminals, and sometimes the number of various applications. In this report, smart infrastructure is mainly limited to the hardware part, while software aspects such as such applications are placed in various services and industrial development.

Table 2-1 Ranking of Smart Infrastructure by sub index

CITY	Mobile Phone	Next-generation Network	Export Bandwidth	Data Center	Smart Infrastructure	Ranking
Hong Kong	100.0	99.0	100.0	87.0	96.5	1
Singapore	90.6	100.0	95.0	100.0	96.4	2
London	86.7	99.3	83.7	90.0	89.9	3
Los Angeles	87.3	99.8	66.9	97.8	87.9	4
New York	87.3	99.8	66.9	97.8	87.9	4
Chicago	87.3	99.8	66.9	97.8	87.9	4
Dubai	97.0	99.6	79.1	64.4	85.0	7
Berlin	88.1	96.5	55.3	96.4	84.1	8
Sydney	85.6	99.0	58.3	91.7	83.7	9
Toronto	80.7	98.5	59.5	91.1	82.5	10
Paris	84.6	98.0	55.4	87.5	81.3	11
Tokyo	88.7	99.0	44.6	82.5	78.7	12
Seoul	87.5	99.9	58.8	67.3	78.4	13
Buenos Aires	89.5	85.0	51.5	66.4	73.1	14
Beijing	93.4	98.0	46.1	53.8	72.8	15
Moscow	91.7	62.0	58.6	75.4	71.9	16
Shanghai	89.1	98.0	46.1	53.8	71.7	17
Rio de Janeiro	85.7	83.1	46.6	67.1	70.6	18
Mumbai	81.0	88.0	45.1	46.1	65.1	19
Cairo	84.4	61.0	38.4	31.4	53.8	20

As can be seen from table 2-1, Hong Kong, Singapore, London, Los Angeles, New York and Chicago are in the leading position in the field of smart infrastructure, reflecting the first mover advantage of smart city construction. Dubai, Berlin, Sydney, Toronto, Paris, Tokyo, Seoul, Buenos Aires and Beijing ranked 7-15, respectively. Generally speaking, compared with the leading cities, it has a relatively obvious gap in export bandwidth. On the whole, Moscow, Shanghai, Rio de Janeiro, Mumbai and Cairo are relatively backward in the above four smart infrastructure evaluation indicators, especially in the construction of data centers. However, it is worth noting that the data center construction dimension here is based on the number of secure Internet servers owned by millions of people at the national level according to the World Bank statistics. Obviously, this index is underestimated for China, India and Brazil, which are developing countries with large population.



### Mobile Phone

Mobile phone is a basic configuration in the current mobile Internet era. For global smart cities, most of them have exceeded 100%. Therefore, the difference in scores on this indicator is not large. The more prominent ones are Hong Kong and Singapore.



### A New Generation of Mobile Communication Network

mainly refers to the penetration rate of 4G, and mobile communication is the foundation for guaranteeing data transmission and Internet service quality. With the development of 5G in recent years, this indicator will be dynamically updated. There are differences in the popularity of 4G in major cities, from 100% in Singapore to 61% in Cairo.



### Export Bandwidth

Compared with the new generation of mobile communication network indicators, export bandwidth mainly reflects the city's global connection capability and level. Global smart cities are much higher than other cities in the country in terms of global connectivity, and they are the most important communication hub in a country and the main channel for the import and export of Internet data. As far as internet data flow is concerned, the export bandwidth indicator fully reflects the city's data communication development level.



### Data Center

Data is the most important resource today. With the rapid development of the Internet of Things, it has shown an exponential growth trend in recent years. Due to the lack of city-level data statistics, the Department uses country-level data collected by the World Bank as a substitute. Obviously, for a populous country like China and India, its major cities are underestimated on this indicator.



## Hong Kong: Excellent Digital Infrastructure

As an important financial center and trading hub in the world, Hong Kong ranks among the world's forefront in economic, political, and cultural development. In recent years, in order to improve the living standards of urban residents and the operational efficiency of the city, the Hong Kong government has strived to build Hong Kong into a world-class smart city. In December 2017, the Hong Kong Government announced the "Hong Kong Smart City Blueprint." The vision of Hong Kong is to build a world-renowned, economically prosperous and smart Hong Kong with a high-quality life". To build a world-class smart city, it must be supported by advanced information infrastructure. After years of construction, Hong Kong's information infrastructure has achieved remarkable results.

Hong Kong has a well-developed internet network and is an information and communication technology hub. Hong Kong currently has eleven cable systems and multiple land-based cable systems connecting four telecommunications operators in the Mainland, and operates eleven satellites to provide external communications services. At the same time, there are four local telecommunications operators in Hong Kong: China Mobile Hong Kong, Hong Kong Telecom, Hutchison Whampoa and SmartOne, and the market competition among them is fierce. Thanks to the above convenient communication network and the fiercely competitive telecommunications market, Hong Kong citizens can enjoy affordable internet services. As of January 2020, Hong Kong's mobile phone penetration rate was 283.7%, one of the highest in the world; the number of mobile phone users using mobile data services was 23.52 million, and the average mobile data usage per user reached 2965 million bytes. In addition to mobile communication

networks, Hong Kong's fixed broadband network coverage and download speed are also among the highest in the world. Hong Kong's broadband network covers almost all commercial and residential buildings in Hong Kong. The penetration rate of broadband access by households in Hong Kong is 93.6%. The average download speed of fixed-line broadband is 176.7 megabits per second, which is among the fastest in the world.

Hong Kong is the preferred location for international companies to develop data centers. Hong Kong has a sound telecommunications infrastructure, reliable and relatively inexpensive power supply, knowledgeable professionals and government support. These favorable factors make Hong Kong an ideal location for international companies to develop data centers. In order to make Hong Kong the preferred location for setting up data centers in the Asia-Pacific region, the Hong Kong government has launched a number of promotional measures. For example, in the site selection for setting up data centers, the government encourages the use of industrial buildings and converts industrial buildings to data center purposes. The government will waive the "exemption fee" for changing the use of land and buildings; develop on industrial land through amendments to the land lease for high-end data centers, the government will assess the land premium based on the use of high-end data centers and actual development density. In addition, the government has reserved three hectares of land in Tseung Kwan O for the development of high-end data centers. The Hong Kong government's policies and measures in data center location selection have greatly reduced the land cost for data center establishment and are also conducive to the optimal use of land resources.



## 2.2 Smart Economy

Smart city aims to establish a virtual image of a real city through intelligent system, using technology modes such as IOT (Internet of Things), Cloud Computing, Ubiquitous Network, Artificial Intelligence and Big Data. Through the integration of information system, it can adjust the redundant, mismatched and incoherent of urban transportation, energy, medical care, and government affairs, and create a new urban operation mode. Smart city is supported by information industry, which includes information manufacturing industry and information service industry. Information industry supports information collection, sorting, storage and transmission from software and hardware. The development of information industry is of great significance to the development of the whole national economy. Information industry is the basis of improving the urban economy productivity. It promotes the development of technology intensive industrial clusters and the adjustment of urban industrial structure. The operation of information industry and its spillover effect in economic society have created the smart economy of city.

This section uses four indicators to interpret the smart economy, which are interactive design, software development, digital application and ICT industry level. From the application of information technology in creative design, the development level of the city in software development, the development vitality of the city in digital economy, and the energy level of the city's information service industry, these indicators comprehensively investigate the level of a city's smart economy, and build a solid smart economic system.

Table 2-2 Ranking of smart economy cities

CITY	Interactive Design	Software Development	Digital Applications	ICT Industry Level	Smart Economy	Ranking
New York	75.0	99.0	84.6	100.0	89.6	1
London	85.0	100	92.0	49.8	81.7	2
Bei Jing	100.0	82.0	73.1	64.6	79.9	3
Shanghai	75.0	78.6	70.9	92.0	79.1	4
Paris	30.0	96.0	100.0	64.4	72.6	5
Singapore	42.5	94.5	84.6	67.6	72.3	6
Chicago	60.0	94.1	66.3	59.3	69.9	7
Los Angeles	62.5	85.3	82.9	47.4	69.5	8
Tokyo	12.5	87.8	88.0	78.2	66.6	9
Hong Kong	25.0	90.2	81.7	63.0	65.0	10
Toronto	45.0	93.3	73.1	48.2	64.9	11
Sydney	42.5	79.1	65.7	54.3	60.4	12
Dubai	62.5	65.0	48.0	63.4	59.7	13
Seoul	12.5	75.6	89.1	58.5	58.9	14
Berlin	15.0	95.3	76.0	48.6	58.7	15
Moscow	25.0	72.4	72.6	56.7	56.7	16
Mumbai	22.5	78.6	21.1	65.0	46.8	17
Buenos Aires	12.5	57.8	32.0	57.8	40.0	18
Rio de Janeiro	12.5	55.3	30.3	47.7	36.5	19
Cairo	10.0	52.1	20.0	35.4	29.4	20

It can be seen from the table that [New York, London, Beijing, Shanghai and Paris are ranked in the top five](#). Compared with the previous ranking, we can get that [the status of China's cities has been significantly improved and it reflects the overall development level of China's smart economy with a very strong international competitiveness](#). Singapore, Chicago, Los Angeles, Tokyo, Hong Kong and Toronto are all global cities with smart economy as the core strategy of urban development. All cities are located in the Asia Pacific region or North America, which to some extent reflects the leading position of these two regions in the era of smart economy. Sydney, Dubai, Berlin and Moscow are the node cities in various regions, with the level of smart economy matching the energy level of nodes. What is surprising is that the evaluation focuses on application, so it does not take Seoul's strong information manufacturing capability into consideration. The lack of its regional hinterland restricts Seoul to become a cutting-edge smart economy city. Although Mumbai has a good performance in software development and information capacity level, which reflects its potential as an emerging smart economy base, its application in the social and economic fields and the lack of working and living environment restrict its further progress in the list. Buenos Aires, Rio, Cairo and other cities lag behind the above-mentioned cities in all indicators, which are subject to the influence of their economic and political environment to a certain extent.



## Interactive Design

The interaction between virtual and entity has become the main feature of the design industry, and the new design industry has also become a landmark component of the content industry. We selected the world's top advertising design companies, as well as the distribution of engineering and construction companies in major cities to represent the development level of graphic design and modeling design industry respectively. [In this regard, Beijing is the most prominent, reflecting the status of the national cultural center and the National Visual Arts Center](#). In addition, the agglomeration of large state-owned engineering enterprises makes its design capacity at the forefront of global cities. London, New York and Shanghai, which are the centers of the global advertising industry, the gathering places of the top architectural design firms, or the design institutes with outstanding spillover effects, are the next outstanding ones. Today, with the interaction between information technology and traditional design methods, these cities have become the industry centers of the world.



## Software Development

Software development capability represents the ability of a city's software products and the level of factor market development. The index comprehensively investigates several key indicators of software development capability industry, the core sector of digital content industry, including business environment, legal environment, market conditions, talent reserve, degree of specialization, infrastructure and connectivity, and living environment. [London, New York, Paris, Berlin, Singapore,](#)

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Chicago, Toronto and Hong Kong are the most prominent in this field. These cities have stable legal environment and abundant talent market. In the city facing the global software and hardware connectivity, can provide very full convenience. Tokyo, Los Angeles, Beijing, Shanghai, Mumbai and other cities are not very different from the first tier cities. They have always been global multimedia centers, such as Tokyo and Los Angeles; or they are emerging global software industry centers in recent years, with prominent software industry clusters, such as Beijing, Shanghai and Mumbai



## Digital Applications

This indicator comprehensively reflects the ICT application ability of a city, as well as the quality and cost of relevant talents. It includes the availability of ICT software, the availability of ICT professional scientists and engineers, the availability of venture capital, the ability of software R & D and export, the specialization of software development capability, the scale of leisure and entertainment sectors, the degree of specialization and track record, information technology facilities, quality of life and skill availability. This index reflects the ideal working and living environment for digital economy industry. Paris and London are the most prominent cities in this respect. These two cities are famous university cities. The number of engineers is developing in scale, and the urban environment can provide a better balance of work and life. Next are Seoul, Tokyo, New York, Singapore, Los Angeles and Hong Kong. These cities either regard digital economy industry as the top priority of economic development categories, such as Seoul, Tokyo and Singapore, or other industries closely related to the digital economy and with outstanding energy level, such as Hollywood in Los Angeles, finance and Commerce in New York and Hong Kong.



## Information Capacity Level

The energy level of the information service industry is a landmark indicator of a smart city. Considering that this data is difficult to obtain, and even if there are cities with such data, its connotation is quite different. We select the distribution of the world's major information industry consulting companies and information industry operating companies to evaluate the development level of the city's information service industry. New York and Shanghai, the two largest economies in the world, are the most prominent in this respect. There is a big gap between the cities ranked at the bottom and those with higher energy level include Tokyo, Singapore, Bombay, Beijing, Paris, Dubai and Hong Kong. These cities are either regional economic centers of information service industry or emerging information industry city clusters, which are eye-catching in the new information society.



## Shanghai: new power of digital industry

Shanghai's excellent performance in credit capacity ranking not only reflects the positioning of Shanghai as a global science and technology innovation center, but also reflects Shanghai's huge advantages in the related industries that constitute the smart economy. We list several industrial forces in Shanghai, which together create **Shanghai's position as a new global highland of digital enabling industry.**

The first is the Zhangjiang microelectronics industry cluster on semiconductors, chips and integrated circuits. This is the domestic and international advantages of Shanghai, and also a landmark industry of China's independent science and technology. Under the turbulent international situation, it will be the main focus of the industry in the next few years, and will continue to promote the upgrading of Shanghai's information industry.

The second is the artificial intelligence industry. Today, artificial intelligence has become the focus of competition among major cities and IT companies. However, in addition to some public areas such as security, the market demand is not obvious, and it may be necessary to upgrade in the field of industrial

automation. Shanghai has a large number of large-scale state-owned enterprises, such as aviation, electrical, shipbuilding, port machinery, steel, petrochemical, automobile and so on. The supply chain organization of these industries is complex, which originates from the layout of the national industrial system, and is an important support of China's industrial system. The industry demand brought by industrial automation and informatization is a broad application area of Shanghai's information industry.

The third is life smart service. Due to the high population density and high income level in Shanghai, some models can be easily transplanted to the surrounding Yangtze River Delta region. As a result, many online economic models based on new lifestyles can take the lead in Shanghai, and Shanghai has become a model innovation gathering place for vertical industry stars. For example, Ctrip and Helloglobal, Meituan on catering, Dingdong in community logistics, Pinduoduo in shopping, Xiaohongshu in life, etc.



## 2.3 Smart Service

Smart service for smart city refers to that in the environment of smart city, aiming at the construction and development of smart city and the information needs that people may encounter in their daily life, through dynamic perception, taking users as the center, making full use of advanced information and communication technology to improve the "intelligence" of urban product service, In order to create high-quality ecological and living environment and enhance the "wisdom" of urban people, so as to make urban facilities more advanced, more scientific in development, more efficient in management, more pragmatic in implementation, more green in environment, more secure in order, more harmonious in society and better in life.

Smart service mainly reflects the main digital service level for the public. The intelligence of the city is an important direction of urban development. In the process of urban development, people-oriented must be taken as the foothold. At the same time, the primary standard to measure the wisdom of a city is whether the citizens have a higher sense of happiness. Therefore, smart city service emphasizes the people as the center and faces all aspects of people's life. Smart city services mainly focus on medical care, transportation, education, employment and other fields, providing efficient, rich and convenient livelihood services to meet the needs of the citizens. At the same time, it can improve the enthusiasm of citizens to participate, and realize the benign interaction between the active participation of the public and the improvement of smart services, so as to promote the construction and development of smart city.

This study selects four main parts of urban citizen services as the evaluation indicators of smart city services: the first part is medical and health services; the second part is public transport services; the third is smart education services; the fourth is employment information services. These four aspects focus on different aspects of smart city services, which can improve the construction efficiency of the whole city and citizens' happiness.

Table 2-3 Ranking of smart service

CITY	Online healthcare	Convenient Transportation	Online Education	Online Employment	Smart Service	Ranking
Shanghai	95.9	91.3	<b>100.0</b>	98.1	96.3	1
Bei Jing	<b>100.0</b>	73.7	94.1	<b>100.0</b>	92.0	2
Dubai	92.6	84.1	91.7	86.6	88.8	3
Singapore	89.0	80.8	80.6	92.7	85.8	4
Moscow	78.6	75.2	72.2	89.2	78.8	5
London	71.2	96.8	68.8	74.7	77.9	6
Paris	75.1	100.0	67.8	65.1	77.0	7
Hong Kong	62.9	86.2	72.4	78.7	75.1	8
Seoul	68.7	80.6	72.9	77.9	75.0	9
New York	72.6	91.7	57.0	77.7	74.7	10
Mumbai	80.1	30.8	80.3	89.5	70.2	11
Chicago	67.6	73.7	55.4	78.4	68.8	12
Sydney	70.6	56.3	62.3	84.6	68.4	13
Tokyo	70.9	84.2	37.0	79.3	67.9	14
Toronto	63.1	64.4	61.2	75.7	66.1	15
Los Angeles	63.1	56.7	63.7	78.4	65.5	16
Burlin	50.1	68.3	55.1	76.1	62.4	17
Cairo	68.0	45.1	47.1	73.5	58.4	18
Buenos Aires	64.3	51.6	43.1	58.0	54.2	19
Rio de Janeiro	32.9	42.6	28.8	54.6	39.7	20

According to table 2-3, Shanghai, Beijing and Dubai rank in the top three. Although these three cities are cities in developing countries, they have made great achievements in promoting information transparency, handling affairs online and providing digital services. Moscow, London, Paris, Hong Kong, Seoul, Bombay and other cities, with convenient transportation or online employment, have obvious structural advantages. Although Chicago, Sydney, Tokyo, Berlin and other cities ranked 12-17 are developed cities, the level of smart service is low, especially in online education. Cairo, Buenos Aires, Rio de Janeiro and other cities lag behind the above-mentioned cities in all indicators, which are subject to the influence of their economic and political environment to a certain extent.



## Medical and Health Services

There are many problems in the medical and health field, such as imbalance of medical resources and asymmetric information between doctors and patients. With the rapid development of Internet information technology, the construction concept of smart medical has been constantly improved and developed. As an important part of the construction of smart city, smart medicine is also the key link and core content of smart service construction. This mode can make use of Internet information technology to realize the co construction and sharing of medical information in the national medical system, which is conducive to simplify the process of patients' medical treatment and facilitate doctors to master the patient information. Smart medical can effectively promote the benign interaction between doctors and doctors, doctors and patients, doctors and equipment, and optimize and improve the resource allocation of medical activities by using data analysis and resource integration. In addition, the construction and sharing of information also reduces the information asymmetry between doctors and patients, promotes the openness and transparency of the medical process, reduces the conflicts between doctors and patients, and effectively protects the rights and interests of both doctors and patients, so as to enhance the stability and security of society. The smart medical model has already been launched in developed countries, such as America, Japan and Europe.

[The development of smart medical industry in the United States is becoming mature, and has a strong R & D capability of smart medical technology.](#) At present, online medical information exchange system has been widely established in the United States, and advanced information technology is used to provide telemedicine services for patients in different places.

[Japan's "cloud technology" \(online storage technology\) can unify and integrate personal medical data.](#) The younger generation of Japanese can use cloud technology to establish their own medical database, and even individuals can access all kinds of medical information stored in the cloud at any time through the Internet. Combined with the published treatment data, they can completely realize the "self-understanding, self-viewing, self-grasping" choice of medical behavior and place.

[China also began to implement the construction of smart health care after 2010.](#) In the past two years, smart phones and mobile medical have opened many new application scenarios, which are mainly divided into B2B mode for hospitals and doctors and B2C mode for users directly.

The former is mainly for professionals to provide medical knowledge, while the latter is for telemedicine health consultation application of "self inspection + inquiry". This new medical mode can simplify the medical treatment process and reduce medical expenses for users; for doctors, it can not only reduce labor time, but also improve the quality of patient management and improve the level of diagnosis and treatment; for the hospital, it can more directly understand the needs of patients, serve patients, improve service satisfaction, and build a harmonious doctor-patient relationship

[ICT and remote assistance are used to prevent and diagnose diseases and provide medical services.](#) The provision of an effective health care system for all citizens is characterized by adequate facilities and services. It reflects the application degree of Internet information technology in the medical industry, which is helpful to solve the imbalance of medical resources and asymmetric information between doctors and patients. This index mainly investigated the improvement of online medical appointment to visit.



## Public Transport Services

Transportation is an important factor affecting social and economic development, work, production and living standards. In recent years, with the rapid development of economy, people's life philosophy and lifestyle are also constantly optimized. However, with the increasing traffic volume, serious traffic congestion and bad traffic environment are disturbing people's travel and health, increasing the unstable factors in the city.

Especially in big cities, traffic congestion is very common, traffic accidents are more frequent, environmental pollution caused by exhaust emissions is increasing. Therefore, in order to quickly be adapt to the corresponding requirements of the development of the times for urban traffic, the construction of intelligent transportation is imminent.

With intelligent mode in traffic management and technology application, intelligent transportation integrates communication and transmission technology, navigation and positioning technology and information technology, expands the traffic management system, realizes comprehensive transportation supervision in an all-round and timely manner, and creates a comprehensive transportation management system.

On the one hand, the construction of intelligent transportation can ensure the development of urban transportation and improve the efficiency of transportation; on the other hand, it can reduce the consumption of energy and resources, save the cost of transportation industry development, and realize the harmonious development of transportation and environmental protection.

More importantly, on the basis of helping the city improve the efficiency of traffic supervision, intelligent transportation can relieve the traffic pressure, improve the traffic safety coefficient, provide more intelligent and humanized traffic services for travelers, create a green and safe smooth traffic environment, so as to improve the public's traffic satisfaction and create a better life.



In this paper, “convenient transportation” reflects the effectiveness, reliability and safety of public transport network.

This index mainly includes commuting time, traffic congestion and taxi fare .And commuting time is the average value of the following values: (1) the time required for one-way work or school in the target city according to the digital “traffic”; (2) the time required for one-way work or school in the target city according to the residents' questionnaire. Traffic congestion the degree of traffic congestion (expressed as a percentage) in each target city is compared with the average additional travel time accumulated due to traffic congestion. Taxi fares are measured in terms of the target city's 5-kilometer taxi fare as mentioned in UBS's “prices and revenues.”.



## Smart Education Services

Smart education refers to the modern information technology represented by the Internet of things, cloud computing, big data processing, wireless broadband network as the foundation, the Internet and intelligent instruments and equipment as the bedding, the construction of a large number of educational resources as the center, through various supporting measures, deepening the reform of the education system, and comprehensively implementing and constructing the network, digital, personalized and intelligent Modern education system is a modern education service system which is led by the government and participated by schools, enterprises and related institutions.

Smart education is an important part of smart city, providing talent guarantee for the healthy and smooth development of smart city. Under the support of modern information technology, [it advocates the concept of lifelong education, promotes the integration and sharing of high-quality educational resources, and makes education break through the limitation of time and space](#). Wisdom education has the attributes of "education" and "informatization". From its educational attribute, wisdom education has the characteristics of cooperation, openness, sharing and interaction. From the perspective of information technology, intelligent education has the characteristics of network, digitization, multimedia and intelligence.

Many countries have taken smart education as an important strategy of education development.

[The United States in "NETP" 2010 emphasizes the use of information technology to build a learning model in the 21st century](#), and comprehensively enhance the deep integration of technology and education.

[Singapore launched "iN2015" in 2006](#), and plans to build an information technology and communication ecosystem covering all walks of life before 2015. Smart education is an important part of the plan. In 2014, it further proposed the "smart country 2025 plan" to build "future school" and "education laboratory".

[In 2010, the Ministry of general affairs of Japan launched the national education informatization project "future campus" smart education project](#), which established a computer application system with good human-computer interaction, interactive

whiteboard and collaborative education platform connecting home and school.

[In the education informatization 2.0 action plan issued in 2018](#), China clearly proposed that "based on emerging technologies such as artificial intelligence, big data and Internet of things, relying on various intelligent devices and networks, China will actively carry out research and demonstration of intelligent education innovation, and promote the mode transformation and ecological reconstruction of education supported by new technologies."

Content dissemination and rapid learning through the application of information technology and Internet technology will create more opportunities for students and teachers to use ICT tools. With the help of network, learning is no longer limited by time and space. This index mainly includes the opportunity of lifelong learning and the application of information technology skills in schools.



## Employment Information Services

“Informatization” of employment service refers to the provision of 24 hours a day, 365 days a year employment services by improving the informatization function of employment network, optimizing the employment service platform, improving the accuracy of intelligent recommendation, the efficiency of intelligent recommendation and the diversity of intelligent recommendation.

No longer limited by the traditional on-site recruitment activities, fully tapping online recruitment resources, enriching online recruitment information, making full use of information technology, expanding the employment market, and using online employment platform to realize online recruitment, online employment procedures and other ways will all be realized to provide convenient employment services for enterprises and job seekers.

In smart city service, employment is an important factor to promote economic development and maintain social stability. It is necessary to strengthen the integration of public employment and talent service information network, promote the sharing of employment information resources, provide an equal employment opportunity for the public, and consolidate and promote the stability of employment.

In addition, to promote the improvement of social security system, improve the level of security, and realize the networking and automation of social security services, people can handle relevant business through the network, such as unemployment registration, social security information inquiry, etc., which is conducive to the expansion of social insurance coverage. Social security service and economic and social development are inseparable. The gradual intelligent improvement of its system can effectively improve the service quality of smart city, improve the satisfaction of the public, and further promote social stability and economic development.

Online employment reflects the informatization of employment services, promotes the matching of employment units and employees, and provides effective and equal employment opportunities. The indicators mainly include employment service security, online access to the work list, making it easier to find a job.



## Paris: the practice of intelligent public transportation

Paris ranks first in terms of convenient transportation, which is mainly due to its vigorous introduction of intelligent information technology and application in the field of public transportation, so as to improve the traffic congestion problem faced by metropolis to the greatest extent.

In June 2013, Snips and SNCF (French National Railway Corporation) held a press conference in Paris to announce the application of tranquilien software. [Tranquilien is a mobile transportation application that allows people to verify train congestion ahead of time so that they can choose a vacant seat.](#) This not only makes passengers more comfortable, but also helps to reduce delays, ease peak hours by making more trains, expanding the passenger load, and improving the overall efficiency of the network. Users can also contribute to the operation of the system by reporting train congestion directly to the application.

Snips has developed an algorithm that can predict how many people on each train will ride and leave each

station every day, a week in advance. The model uses contextual information, such as work calendar, weather forecast, sociodemographic characteristics near each station, etc. To build the algorithm, Snips aggregates more than 10 different data sources, such as open data (from openstreet maps, Gtfs or general transit feed) (e.g. the number of passengers and the number of passengers, historical data, etc.); the number of passengers and the number of users (e.g., historical data and Applications) are searched.

It was released after 2000 beta testers applied the measurement, which attracted a wide range of interest from commuters, technical experts and journalists. Initially, it could be used on IOS only for Apple phones, limiting the number of potential users to 600000. By the end of the first day, 20000 passengers were already using it. A week later, the app got more than 10000 users to enter, 2000 tweets, more than 200 media articles, five radio interviews, and three TV broadcasts. [The app eventually won the national open data award.](#)

## 2.4 Smart Governance

The construction of smart city is the foundation and opportunity for the transformation from traditional urban management to intelligent governance. Smart governance is more in line with the requirements of national governance modernization, and is one of the internal driving forces and main objectives of smart city construction and continuous deepening development. The construction of smart city provides a solid foundation of software and hardware for smart governance, and the openness and interactivity of the Internet and the awakening of the public's subjective consciousness provide the possibility for smart governance.

In the theoretical system of smart governance, efficiency is no longer the only criterion, and the values of openness, participation and inclusiveness have been paid attention to. In the new era of big data and artificial intelligence, data governance is receiving more and more attention. Therefore, this paper compares and analyzes the smart governance level of different cities from five aspects of data openness, public security, public participation, social inclusion and sustainability.

**Table 2-4 Ranking of smart governance**

CITY	Data Openness	Public Safety	Public Participation	Social Inclusion	Sustainability	Smart Governance	Ranking
London	82.8	56.1	64.6	81.2	86.7	74.3	1
Seoul	100.0	72.6	62.9	67.9	61.1	72.9	2
Dubai	45.7	85.8	92.1	86.3	46.7	71.3	3
Singapore	61.5	80.1	74.1	80.3	56.0	70.4	4
Toronto	83.8	54.7	56.8	71.4	78.8	69.1	5
Shanghai	51.2	82.0	100.0	63.6	48.0	69.0	6
New York	96.7	57.2	57.8	62.8	69.4	68.8	7
Sydney	66.8	61.2	58.8	100.0	53.4	68.0	8
Berlin	48.2	51.0	54.0	84.4	100.0	67.5	9
Bei Jing	44.4	81.0	99.0	63.8	46.8	67.0	10
Paris	81.6	52.4	61.5	69.4	64.6	65.9	11
Los Angeles	83.5	48.8	65.4	70.1	50.8	63.7	12
Chicago	92.6	47.4	58.6	66.6	52.6	63.6	13
Tokyo	76.2	62.6	45.8	79.4	50.2	62.9	14
Mumbai	47.5	76.2	82.1	61.9	46.3	62.8	15
Hong Kong	64.2	61.6	71.1	62.6	53.2	62.5	16
Moscow	55.4	70.6	77.0	60.7	46.6	62.1	17
Buenos Aires	42.0	48.1	56.0	65.4	47.2	51.7	18
Rio de Janeiro	54.9	33.6	33.6	60.3	54.0	47.3	19
Cairo	15.5	58.1	51.9	60.2	45.4	46.2	20

It can be seen from table 2-4 that in the field of smart governance, each city has its own unique advantages, and the overall performance of the top 17 cities is relatively balanced. It is worth noting that Buenos Aires, Rio de Janeiro and Cairo, which are the last three, have a large gap compared with other cities in all dimensions, [It shows that the overall economic and social development of the country and the city is highly related to the smart governance of the city.](#)



### Open Data

Data opening can eliminate the phenomenon of "information isolated island" caused by the poor information exchange among various departments in the city, and protect the common people's right to know about urban public affairs, which is an important basis for the realization of urban intelligent governance.

[According to the "global important cities open data index" issued by Shanghai Academy of Social Sciences](#), this paper carries out the open data work of each city from the following aspects: the legal policy and organizational guarantee of data opening; the depth, breadth, access freedom and activity of data; the use of user data and platform interaction; and the economic, political and social values brought about by open data assessment and scoring.

Seoul is very outstanding in terms of data openness. Cities such as New York, Los Angeles, Chicago and Paris in France perform well. Hong Kong and Shanghai in China perform better than Beijing, but there is still much room for improvement.



### Public Safety

To protect the personal and property safety of urban residents is the function of the government, and it is also an important premise guarantee for a city to attract talents to take root and live and work in peace and contentment.

[The public safety score of this paper is mainly based on the degree to which the urban residents feel safe by installing surveillance video in the city.](#) According to the ranking, Dubai scored the highest in public safety. In addition to installing a large number of monitoring videos in public areas, it is mainly due to the establishment and promotion of its mobile police integrated service platform and intelligent police station, which enables residents to realize the activities of alarm, ticket query and payment at any time through mobile phone app and intelligent police station, which greatly facilitates the life of residents and provides security for their personal safety. Beijing and Shanghai are also outstanding in terms of public security, mainly due to the comprehensive coverage of domestic networks and the laying of a large number of surveillance videos in recent years.



### Public Participation

Public participation in smart governance means that residents can communicate with government departments through mobile phones, tablets, computers and other terminals without leaving their homes. Through the online platform, residents can put forward suggestions for government departments to further improve the appearance of the city, improve the service level of the government, and improve the quality of life of urban residents.



From the ranking, we can see that Shanghai has made remarkable achievements in public participation. One of the typical successful cases is the Shanghai citizen service hotline. Shanghai citizen service hotline (12345) is a non emergency government hotline. It was put into trial operation on October 8, 2012 and officially operated on January 7, 2013. It receives calls from citizens 24 hours a day. It mainly answers all kinds of policy and public information consultation put forward by the public, accepts and handles the help seeking, complaints and suggestions from the public concerning the government's public management and public services. The total number of complaints received by the public through mobile phone was 1.738 million, with a year-on-year increase of 1234 million, and the number of calls received by the public was 1234 million, with a year-on-year increase of 1234 million. According to the third-party evaluation, people's perception and hotline management level lead the country



## Social Inclusion

A normal society must be diversified and colorful, instead of being single and monotonous. The so-called pluralism means that existence is not only a kind of value, but also a way of life. It is because there are different ways of life, the society will be more colorful, people have more options. Only when people are open and tolerant of differences can their creative inspiration be inspired. If there is only one way of life in a society, people's values are similar. If everyone lives in the same way every day, the society will surely lack vitality and vitality, and lack of innovative spirit and motivation.

From the ranking score, we can see that [the social inclusion of a city is closely related to its history](#). Sydney itself is a city of immigrants, known as the "small United Nations". There are more than 140 ethnic groups living here. Therefore, the local social tolerance is very high. Everyone can live in harmony in this city without interference. In addition, Dubai, Berlin and Singapore are also prominent in social inclusion. In contrast, China's Beijing, Shanghai and Hong Kong still need to continue their efforts in this regard.



## Sustainability

Sustainability refers to a process or state that can be maintained for a long time.

The sustainability of human society can be divided into three parts: ecological sustainability, economic sustainability and social sustainability. The relationship between environmental protection and sustainable development is very close. Therefore, in the urban governance, we should not only pay attention to the development of the city, but also pay attention to the environmental protection of the city. Therefore, in the process of intelligent governance, the government should improve people's awareness of environmental protection, solve environmental crisis, change traditional production and consumption patterns, develop science and technology, and accelerate the development of new environmental protection technologies.

In this paper, the sustainability of each city is evaluated based on [the stellar sub index in the sustainable cities index 2018](#). The indicator measures the sustainability attributes of cities, such as green space and pollution, and emphasizes the UN sustainable development goals related to clean water and sanitation, clean energy and climate action.

From the index ranking and score, we can see that Berlin is far ahead of other cities in terms of sustainable development. Beijing, Shanghai and Hong Kong are very backward in this respect, which reflects that China still adopts the traditional development mode, and fails to realize the sustainable development mode of less investment and more output.



## Seoul: An Open Data Plaza

Seoul attaches great importance to opening government data to the public, and has made a lot of beneficial exploration in data governance.

[Seoul put forward the "smart Seoul 2015" plan in 2011, aiming to build Seoul into the world's leading smart city with ICT technology.](#) In April 2012, Seoul developed and established the "open data Plaza", which enables third-party developers and researchers to access urban datasets, from which new services and insights can be generated. It includes ten categories of data: comprehensive administrative documents; welfare, culture and tourism; urban management; environment; public security and safety; education; health; industry; economy; and transportation. Based on these ten categories, 33 Public Information Systems and 880 databases of different types are integrated to provide users with 10 categories of public data information, including child care services, public transport routes, bus arrival time, parking spaces, weather forecast in various regions and restaurant recommendation, covering all aspects of life. Data are provided in the form of maps, website links, charts, metadata, etc. In March 2019, the Seoul municipal government announced that it would invest \$1.2 billion by 2022 to promote the further improvement of smart city.

Park Geun hye, former president of South Korea, actively promoted the government organization reengineering and innovation reform activities with government 3.0 as the main body in June 2013, emphasizing "openness, sharing, exchange and cooperation". The purpose of government 3.0 is to

disclose the data owned by the government and public institutions to the outside world, eliminate the gap between the public sectors, and provide targeted services to the demanders, so as to create a government operation mode with new value. In October 2013, The Act on the Promotion of the Provision and Use of Public Data, a special law for open data in South Korea, officially took effect. In December 2013, the Open Data Strategy Council (ODSC) was established in South Korea As the highest decision-making department in the field of open data in South Korea, it is responsible for reviewing, coordinating and evaluating the implementation of major policies and plans related to public data.

[According to the utilization of open application program interface and the reuse of data, Seoul further opens up useful data except private information of citizens to citizens and enterprises.](#)

Currently, Seoul's open data Plaza has access to more than 7000 datasets, including real-time sensor information, and more than 5500 applications have been created, covering all areas of urban life from health to housing.

The government of Seoul hopes to make more residents participate in urban management, and "community mapping" comes into being. Through geographic information system, mobile Seoul platform and social network, the two-way communication between citizens and municipal institutions can be realized.

## 2.5 Smart Innovation

Smart city can stimulate the government, enterprises and individuals to carry out innovative application of science and technology and business on the basis of smart infrastructure, providing a continuous development power for the city. Extensive innovation is an important feature of smart city. The source of innovation is undoubtedly the development of science and technology and the gathering of talents. In turn, the agglomeration effect of big cities also provides fertile soil for innovation. A study on the United States estimates that, despite industry differences, the cluster efficiency is the highest within the radius of 1 mile, which is 10 times of that at 5 miles, and the return above 10 miles is basically zero. Compared with the suburbs and ordinary cities, the global smart city has more first-class universities and scientific research institutions, and has a higher level of human capital. It is a science and technology innovation city with global influence.

The theory of national innovation system points out that the innovation ability of a country or region depends on the development of its scientific and technological innovation system, including the existence and close interaction of different institutions such as universities, scientific research institutions and enterprises.

Big cities are located in the center of a region and increasingly become the main economic pillar of a country. It has a siphon effect on scientific and technological innovation talents and funds to maintain their regional or global competitiveness. Science and technology can not only provide powerful impetus for economic development, but also bring more extensive social innovation. For example, in terms of residents' health, from infant mortality to the spread of epidemics, it is difficult for cities to maintain and operate health systems with limited financial budgets. A smarter city can use science and technology to comprehensively transform its core system, and maximize the use of limited wisdom resources to create more employment opportunities.

On the level of global smart city, this paper divides the innovation ability among cities into four aspects, namely, the strength of universities, scientific and technological research and development, innovation ability and human skills. The first three sub indicators are closely related, reflecting the strength of urban education, science and technology, innovation and entrepreneurship. The overall idea is to try to analyze the innovation strength of the smart city from different perspectives of production, learning and research.

Table 2-5 Ranking of smart innovation

CITY	Strength of Colleges and Universities	R & D of Science and Technology	Innovation and Entrepreneurship	Human Skills	Smart Innovation	Ranking
London	90.0	83.7	99.0	85.1	89.4	1
New York	65.0	100.0	100.0	81.6	86.7	2
Paris	100.0	51.0	97.5	80.1	82.1	3
Tokyo	75.0	74.0	99.5	79.4	82.0	4
Los Angeles	70.0	72.7	98.5	81.6	80.7	5
Seoul	80.0	65.3	93.5	80.1	79.7	6
Singapore	70.0	49.9	98.0	100.0	79.5	7
Hong Kong	90.0	50.5	72.5	96.9	77.5	8
Chicago	70.0	54.0	97.0	81.6	75.7	9
Sydney	80.0	40.4	93.0	80.1	73.4	10
Bei Jing	75.0	42.8	87.5	80.9	71.5	11
Shanghai	75.0	35.8	84.0	81.6	69.1	12
Berlin	60.0	42.0	94.5	76.7	68.3	13
Toronto	55.0	33.7	95.5	83.3	66.9	14
Moscow	75.0	30.9	81.5	79.4	66.7	15
Dubai	45.0	15.0	85.0	94.0	59.8	16
Buenos Aires	55.0	11.2	66.0	80.1	53.1	17
Rio de Janeiro	50.0	14.5	43.0	86.1	48.4	18
Mumbai	45.0	4.9	58.0	85.1	48.3	19
Cairo	50.0	3.5	16.3	87.0	39.2	20

According to table 2-5, London, New York, Paris, Tokyo and Los Angeles rank in the top five, showing a high overall level in the field of intelligent innovation. Seoul, Singapore, Hong Kong, Chicago, Sydney, Beijing, Shanghai, Berlin, Toronto, Moscow and Dubai ranked among the 6-16 places. Technological research and development is the main gap between them and the leading cities. Buenos Aires, Rio de Janeiro, Mumbai and Cairo are among the last four cities, which have a large gap with other cities mentioned above in terms of science and technology research and development, innovation and entrepreneurship, and University strength. It shows that the comprehensive economic and political environment of the country is consistent with the intelligent innovation level of the head cities of the country.



## University Reputation

Since the middle of the last century, the prosperity of highway 128 in the east of the United States has benefited from MIT teachers' Entrepreneurship and technological knowledge export. Stanford University in San Francisco Bay has become the cradle of Silicon Valley. In many parts of the world, governments are trying to replicate this success story. For global smart cities, the existence of first-class universities may be the core driving force for the development of cities. The spirit of "academic freedom" in universities and the vigor and creativity generated by the gathering of young people can make a city more attractive. At the same time, excellent universities, like a huge magnet, attract outstanding students and scientists from all over the world and become the cornerstone of skilled migration.

Based on the distribution of universities in QS university rankings, this paper examines the strength of different cities in the construction of first-class universities. In some developed countries, there are many universities in big cities with a history of more than 100 years, and their advantages in some disciplines are very obvious. In recent years, the university rankings of some big cities in emerging countries have risen rapidly, and there is a great potential to catch up.

It is worth noting that, due to the national conditions, although the strength of the existing schools in cities like New York is not weak, but due to the land, urban planning and other reasons, universities are more inclined to develop in the suburbs. These universities are not included in the urban scope, so the scores of the first-class universities are not high. The central cities of relatively small countries, such as Paris, almost include the first-class universities in France, thus ranking first in this sub index. London and Hong Kong are ranked second with their excellent university resources.



## R & D

The level of scientific and technological research and development is closely related to the existence of first-class universities. To a large extent, first-class universities are the foundation of scientific and technological research and development. But in addition, there are other kinds of R & D institutions, including the National Laboratory, the engineering technology research center, and the enterprise research laboratory, which can absorb a large number of scientific research personnel and produce patents and academic documents, which can reflect the city's scientific and technological research and development capacity. Therefore, this paper regards R & D as a comprehensive index.

Smart city provides a smart solution for urban sustainable development, which is inseparable from the efforts of science and technology research and development. Information technology itself is a science and technology, science and technology need to be combined with industrial application. Cities can become smart with the help of external development, such as introducing multinational companies with strong scientific and technological strength to settle in or provide solutions. However, if they lack the corresponding scientific research institutions and personnel, they lack the necessary "absorptive capacity", which leads to the lack of sustainability of urban science and technology development, and the city falls into the inferior position in the competition of global cities.

From the ranking score, it can be seen that the gap between cities is bigger because scientific and technological research and development is a more comprehensive indicator than the strength of universities. For example, New York is far ahead of other cities in terms of science and technology, although it is not outstanding in terms of university rankings. In contrast, although Beijing, Shanghai and Hong Kong have made significant progress in university rankings, the overall R & D strength of China's science and technology is far behind that of New York and London.





## Innovation and Entrepreneurship

With the explosive emergence of new information technology, Internet infrastructure and data have become the most important strategic resources, providing a lot of opportunities for innovation and entrepreneurship. This sub index uses the ranking of 2tinknow and global entrepreneurship index on the innovation and entrepreneurship ability of global cities, as a comprehensive index to highlight the comprehensive performance of different cities in innovation and entrepreneurship.

Urban innovation ability is a comprehensive embodiment of technology and economy, and innovation is more focused on industry. Some cities are not among the strongest in science and technology, but because they are suitable for entrepreneurship, a number of global enterprises will emerge, such as Los Angeles and Singapore, while others are on the contrary, such as Hong Kong.

Urban Entrepreneurship is the main driving force of urban industrial renewal and adaptability. In the wave of the new scientific and technological revolution, many traditional urban superior industries will gradually become obsolete and face elimination. Therefore, the city needs a large number of entrepreneurs engaged in science and technology entrepreneurship, introduce new technology into traditional industries, or create new industries, realize from 0 to 1, and then to 100, so as to improve the industrial level of the city.

New York ranked first in this index, far ahead. As a world-class financial center, New York has successfully transformed into a global science and technology innovation center by virtue of its global talent and capital advantages. In 2009, New York released the "diversified City: New York economic diversification plan" to launch the "Eastern Silicon Valley" development plan. The new decade development plan "a new New York City: 2014-2025" issued in 2015 once again defines the urban development orientation of "global capital of innovation". Through continuous improvement of its own scientific and technological strength, such as the construction of "Silicon lane", "maker space", and the launch of "Applied Science" program, the world-class Institute of technology is attracted to settle down through land planning. Google, Facebook, twitter, Microsoft, Yahoo, eBay and other high-tech giants that used to focus on Silicon Valley have also come to set up R & D institutions and business centers in New York.

It is worth mentioning that innovation and entrepreneurship cannot do without the support of venture capital. From 2008 to 2017, the distribution of global venture capital has changed greatly, and Chinese cities have sprung up. In 2008, New York City's main competitors came from California. Of the 20 cities with the highest total venture capital, only four are outside the United States. But by 2017, more than half of the world's top 20 venture capital cities were outside the United States. In addition to California's four exclusive places (Silicon Valley, San Francisco, Los Angeles and San Diego), other capital flows into Beijing, Shanghai, London, Singapore, Hong Kong, Shenzhen, Paris, Berlin, Bangalore, Jakarta and Hangzhou. Among them, Beijing's performance is particularly outstanding, surpassing Silicon Valley in the first place. New York ranked fifth after Shanghai.





## Human Skills

Human skills refer to the number and availability of technical engineers or workers, especially the supply and demand of talents. Senior skilled workers are the important wealth of various industries, reflecting the quality of a city's labor force, and they are a kind of personnel with a serious imbalance between supply and demand in the labor market. Berry and Glaeser (2005) found that in 1940 or 1970, the technical level of cities with higher skilled workers improved more in the following decades. With the population of many countries gradually entering the aging society, how to attract and cultivate excellent skilled workers in smart city has become an urgent task. The development of robot technology is just to deal with this dilemma. According to the hay's global skills index, Singapore ranked the highest in robotics applications in 2016, reaching 488 robots per 10000 employees.

The attraction of skilled workers is different from that of talents. Generally speaking, there are different levels of talent attraction in global smart cities. Some global cities, such as New York, London and Singapore, enjoy a unique position to attract global talents. While other cities mainly attract domestic and regional talents, such as Moscow and Mumbai. Although the work of skilled workers has high technical content, it is closely related to the local industrial structure.



## London: Global Financial & Science and Technology Innovation Center

Fintech has become one of the great success stories in the UK recently. As a traditional financial center, London has continued to make efforts to the science and technology innovation center in recent years. Financial technology, artificial intelligence and blockchain have risen rapidly, becoming the fastest growing industry in London, realizing the perfect combination of Finance and technology.

London has become a European financial technology center in terms of innovation and financing. The key to its success is human source. "42.7 billion" and "high tech" jobs in London together. In 2018 alone, jobs in the fintech sector grew 61%, making it the fastest growing sector in London. One third of the posts in financial technology departments are responsible for building engineering backbone networks, while the vacancy rate of IT jobs has increased by 74% year on year.

London is more attractive to technical professionals than any other major European city, with 360000 software developers, a third higher than Paris, which is second place. Technology giants such as Facebook and Amazon have built large infrastructure engineering teams in London. Apple plans to build a new base in Battersea that can employ 1400 people. Google's AI centric deepmind, headquartered in Kings Cross, has expanded to 4500 staff.

In 2018, one third of European fintech venture capital was invested in London companies. London technology start-ups raised 1.8 billion pounds, or 39%, almost twice as much as second place Berlin.

London is close to San Francisco in the number of fintech unicorns. 25% of global entrepreneurs say they have important relationships with more than two people in London. Nine of the world's 29 fintech Unicorn companies are based in the bay area of California and seven in London, including several banking disruptors, such as Transferwise, Oaknorth and Revolut, and the IPO of funding circle, a P2P company.

London has made outstanding achievements in science and technology entrepreneurship culture, which is reflected in the start-up and construction of Silicon Roundabout. More and more high-tech start-ups are appearing near London Bridge, Soutbank and N1 post districts. According to the statistics of UHY hacker young, the number of newly established enterprises in the City Road (N1 postal district) alone jumped from 8400 in 2015 to 14710 in 2016, an increase of 75%.

TechHub, launched in 2010, is part of London's silicon ring project. It was initially sponsored by Google and formed a global strategic cooperation with Google and BT. Since 2011, it has set up several branches in Latvian, Poland, Romania, Bangalore, Spain, New York of the United States and other places, becoming a global community for technology entrepreneurs and start-ups, providing services to more than 750 companies around the world, and incubating a number of science and technology enterprises such as Monomics, Second Sync, Divide, Nexmo, Swiftkey, Wercker, Callsign, etc.

## 2.6 Smart Reputation

Major cities around the world have achieved fruitful results in the construction of "smart cities". At the same time, there are many theoretical research results, which reflect the construction results of smart cities from different sides, and reflect the degree of attention to the city. To this end, we track the reputation of smart cities with the help of academic databases, and examine the reputation of global smart cities from an academic perspective by tracing the frequency of different cities in academic literature.

We use "smart cities/smart city", plus the English names of different cities to search for academic literature in the article title, keywords, and abstracts with the time between 2010.1-2020.5 in the Web of Science database. We found 1100 English literature and use them to build the original database.

By reading the abstracts of these literature, selecting research content related to smart city models, applications, and data generated by smart city construction, there are 519 articles meet the requirements. The distribution is shown in the following table.

Table 2-6 Distribution of academic documents related to global smart cities (2010-2020.5)

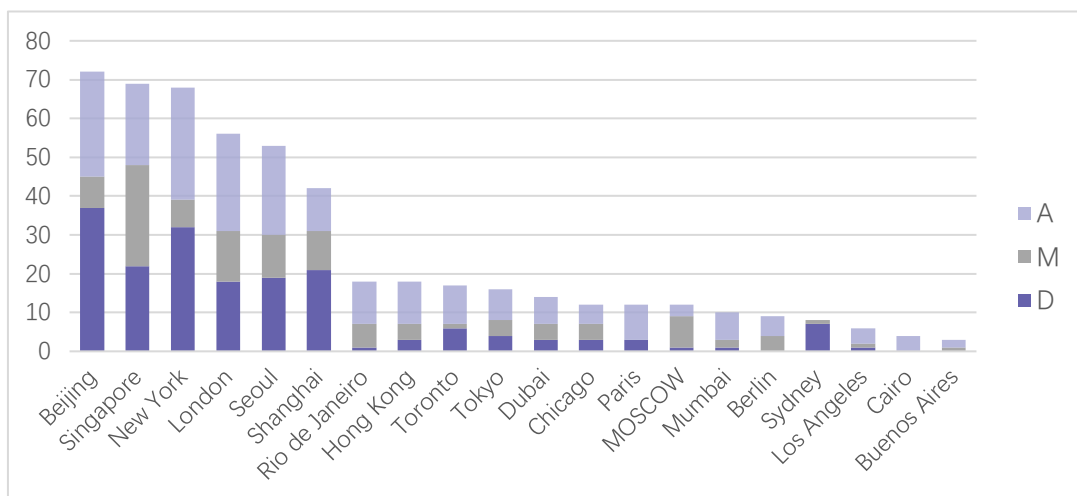
city	Number of literature	Reputation Ranking	Smart City Ranking	Difference
Beijing	72	1	5	4
Singapore	69	2	3	1
New York	68	3	2	-1
London	56	4	1	-3
Seoul	53	5	10	5
Shanghai	42	6	4	-2
Rio de Janeiro	18	7	19	12
Hong Kong	18	8	7	-1
Toronto	17	9	14	5
Tokyo	16	10	12	2
Dubai	14	11	11	0
Chicago	12	12	9	-3
Paris	12	12	6	-6
Moscow	12	12	16	4
Mumbai	10	15	17	2
Berlin	9	16	15	-1
Sydney	8	17	13	-4
Los Angeles	6	18	8	-10
Cairo	4	19	20	1
Buenos Aires	3	20	18	-2
<b>Total</b>	<b>519</b>			

From Table 2-6, we can see that Beijing, Singapore, and New York rank in the top three in terms of attention paid to smart city research, with similar reputations. In English academic literature, it is not easy for a city in a non-English speaking country to receive more attention than an English speaking country.

Judging from the difference between the two rankings, the most significant is that Rio de Janeiro's academic reputation is much higher than its wisdom ranking. While Los Angeles is just the opposite, the relevant research literature is far less than its actual degree of wisdom.

According to the top-level design of smart cities, that is, the macro model of urban smart cities, the specific applications or optimization of specific applications of smart cities, and the results and spillover effects based on smart city applications, we divide the topics of the existing literature into A (applications), M (mode), D (data) three sub-categories, arranged by city, year, and classification. The results are shown in the Figure 2-1.

Figure 2-1 The number of academic articles distributed in global smart cities



From the sub-item point of view, there is generally a three-pronged situation: [Beijing ranks first in terms of applications and data](#); [Singapore is most favored by academia in terms of model](#), and is considered to be a model for smart cities; [New York has a comparative advantage in data aspect](#).

### 3. Conclusion

The construction of a smart city involves the well-being of hundreds of millions of people on the planet. It is not only an application of information and communication technology in cities and regions, but also closely related to the lives of citizens. It is also the key to the realization of the 2030 Sustainable Development Goals proposed by the United Nations. As the 20 "global smart cities" listed in this report, they are among the best in global cities. They should become the benchmarks of world cities in five aspects: smart infrastructure, economy, service, governance and innovation.

This report proposes a "5+1" framework system to measure the smartness of global cities. The ranking method of "Global Smart City" has been upgraded to more systematically, accurately and dynamically reflect the status and progress of smart cities in different cities.

Based on the top five indicators, the ranking results show that the global capital of wisdom can be divided into three levels: leading, advanced and following. In the five sub-indices, different cities have their own characteristics and become benchmark cities for sub-indices.

In order to contrast with the above relatively objective measurement methods, this topic also specifically examines another indicator, the academic reputation of smart cities, that is, the academic community's attention to the smartness of each city. From the comparison of the two rankings, we can find there is a certain difference between construction practice and academic attention.

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## Appendix: Indicators

Pillars	Sub index	Weight	Data source	Description
<b>Smart infrastructure</b>	Mobile phone	25%	ITU	penetration
	Next-generation network	25%	ITU/Telecom Operators	4G penetration
	Export bandwidth	25%	ITU	Bandwidth per capita
	Data center	25%	World bank	Secure Internet server for every million people
<b>Smart economy</b>	Interactive design	25%	Industry ranking & agency distribution	
	Software development	25%	IBM	
	Digital applications	25%	PWC	
	ICT industry level	25%	Industry ranking & agency distribution	
<b>Smart governance</b>	Open data	20%	Open Data Barometer/Shanghai Academy of Social Sciences Data Open Index	Public data openness
	Public safety	20%	Smart City index	Number of digital monitoring public reflects their opinions online
	Public participation	20%	Smart City index	
	Social inclusion	20%	Cities in motion	Digital gap between different groups
	Sustainability	20%	Sustainable City Ranking	
<b>Smart Services</b>	Online healthcare	25%	Smart City index	Make an appointment via the Internet
	Convenient transportation	25%	Global Power city index	Travel reservation online
	Online education	25%	Smart City index	Education and training via the Internet
	Online employment	25%	Smart City index	find a job online
<b>Smart innovation</b>	University Reputation	25%	QS university ranking	
	R & D	25%	Global Power City Index	
	Innovation and entrepreneurship	25%	2thinknow/ Global Entrepreneurship Index	
	Human skills	25%	Hay's skill index/ Global Competitiveness Index	
<b>Smart reputation</b>	Reflecting the city's smart reputation, or the city's brand image. Just as a reference index, not included in the total score			



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**United Nations**

Public Administration Network  
Information Unit