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Super Smart City

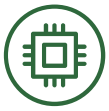
Happier Society with Higher Quality

Contents

1. Smart cities today

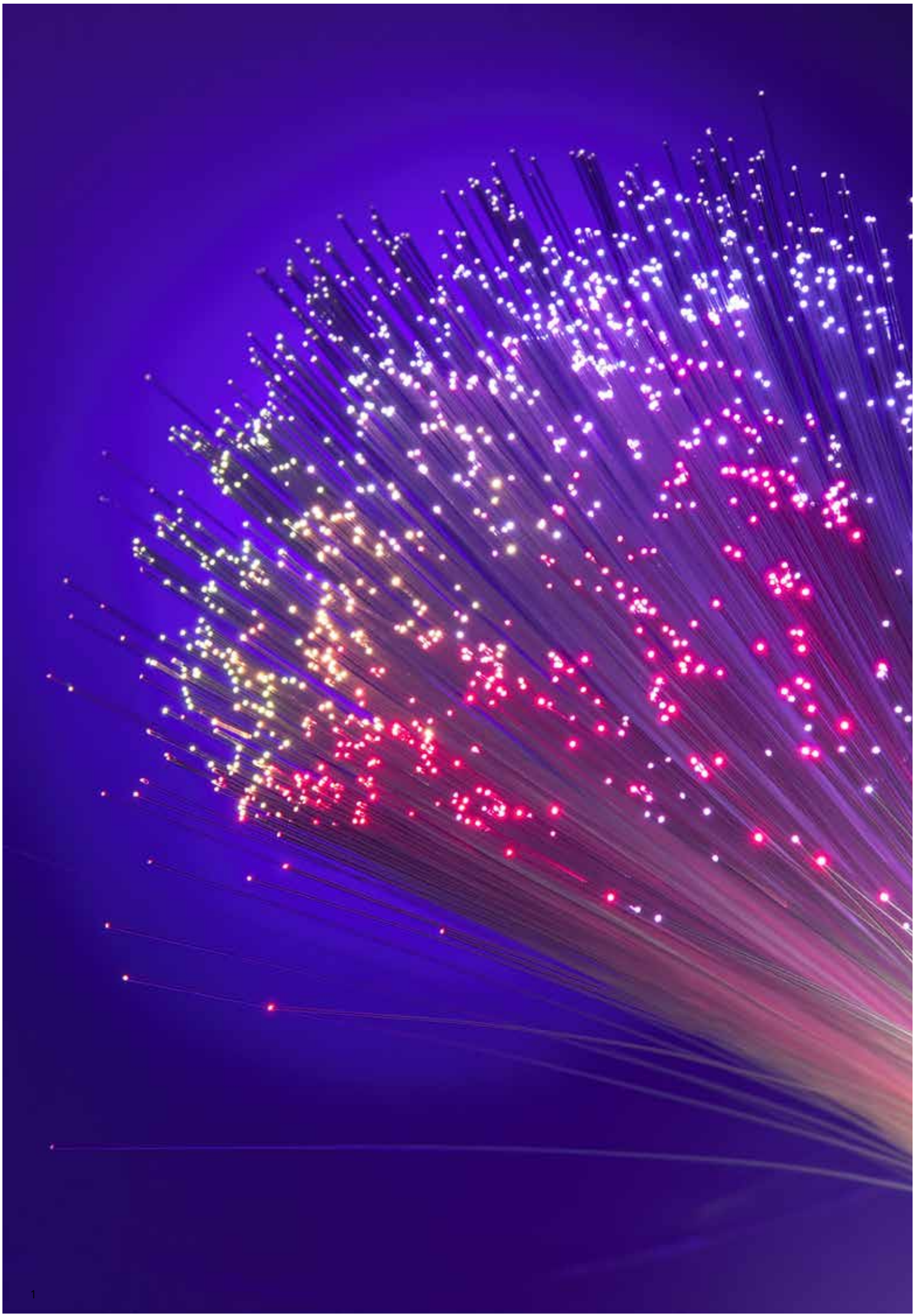
2. Super smart cities in the future

3. China super smart cities index


4. Building a super smart city

5. Seven key lessons

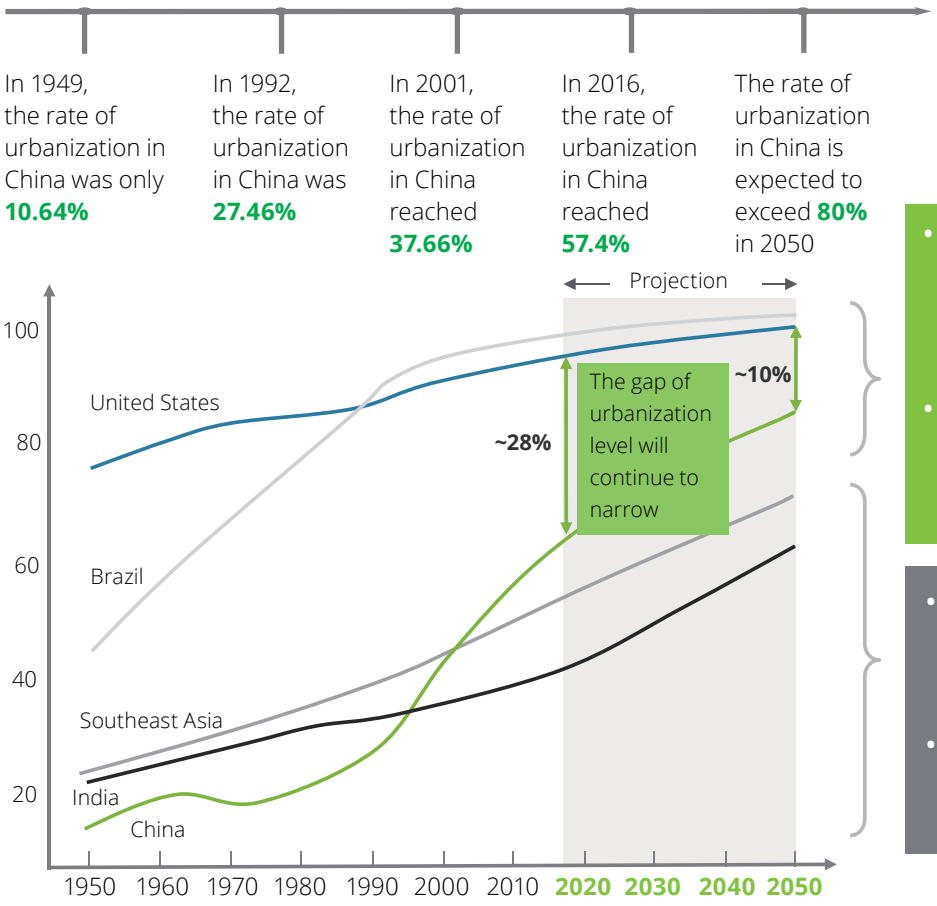
6. Evaluation index system



Smart cities today

Europe and America are leading the world in terms of urbanization, thanks to their first mover advantages. While in Asia, specifically China, the government has been largely promoting urbanization strategy for years, which helps China achieve the highest urbanization growth rate globally and a vast space for development in the future.

Figure: Global urbanization trends (%)



- As the gap keeps narrowing between China and the US in urbanization level, more opportunities for future development can be derived from urbanization in China.
- Driven by its new urbanization strategy, China has seen rapid urbanization with a compound annual growth rate of over 1% in the past decade.

- Asian countries/regions have higher urbanization growth rates than that of American countries, demonstrating huge potential for growth.
- Due to urbanization, Asia faces a gap in infrastructure investment amounting over USD2 trillion per year.

Source: United Nations, National Bureau of Statistics of China, Deloitte Research

Urbanization has varying impact on urban economy, resource utilization, life quality, time cost and sustainable development. The acceleration of urbanization and population growth bring increasingly severe challenges to urban managers around the world.

Population challenges

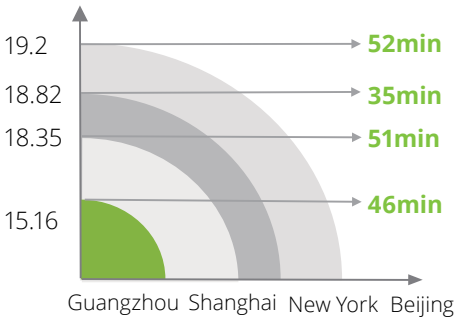
China's total population is close to **1.4** billion
Urban population reached **7.33** million(as of 2016)

Health challenges

- Over **75%** of people in China are in sub-health condition.
- Nutrition-related chronic diseases such as diabetes, cardiovascular disease and tumors are responsible for **80%** of deaths in China.
- By 2020, the number of incapacitated elderly requiring elderly care services will exceed **20million**.

Transportation challenges

Average commute distance/km



- Urban traffic congestion has led to high time cost.
- The average commute time in major cities is over **30min**. The average commute distance in Beijing, Shanghai and Guangzhou is over **15km**.
- Among foreign cities, the average commute time in New York is also over 30 min.

Communication challenges

The rise in demand for communication has posed challenges to the construction of urban network infrastructure and the network operation and maintenance capacity of providers.

Education challenges

- On the one hand, education supply is severely insufficient, but on the other, waste of education resources is substantial.
- The need to align network, training institutions and education resources.

Municipal waste challenges

- By 2025, the amount of waste generated by the world's cities is expected to rise to **2.2 billion tons per year** from the current,**1.3 billion tons** per year. The increase is mainly due to rapid growth of cities in developing countries.
- **China is among the top of the world in terms of municipal waste generation due to a lack of waste disposal technology.**
- In China, **nearly 70%** of the waste is disposed of in landfills. Over **500 million square meters** of land in aggregate has been occupied by dumps in cities around the state, and the annual economic loss is as high as **RMB 30 billion**.

Pollution challenges

- **First, urban air pollution has become the leading threat to the health of urban dwellers.**
- According to WHO, global air pollution levels have increased by **8%** from 2008 to 2013, and only **12%** of the world population are living in cities meeting WHO's air quality guideline levels.
- According to Yale University, China was ranked **the second worst in the world** in terms of air quality, with most of its areas exceeding the safe PM 2.5 level.
- **Second, urban noise pollution has affected the quality of life.**
- In 2016, environmental noise complaints accounted for **43.9%** of total environmental complaints in China, an increase of 8.6% over 2015. In Europe, more than **125 million** of the population are affected by road traffic noise levels that exceed 55 dB.

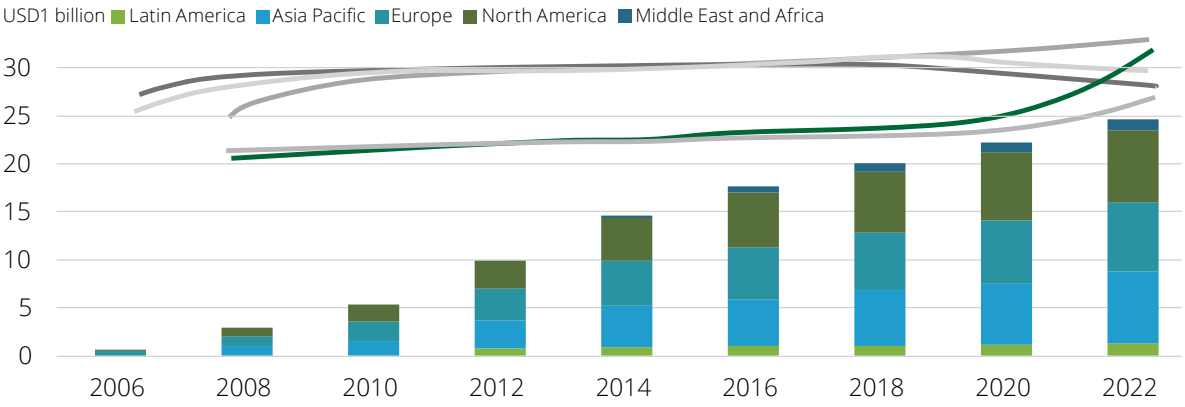
Source: Institute for Urban and Environmental Studies Chinese Academy of Social Sciences, World Bank, Deloitte Research

To address the challenges brought about by urbanization, countries around the world have been making significant investments in the construction of smart cities for over a decade. The amount of investment has been on the increase year over year, and is expected to reach the height in the coming five years, especially in Asian countries, given their late-mover advantages which provided them plenty of room for development in smart cities.

Figure: Amount of investment in "smart cities" worldwide

Smart cities 1.0 stage: first-mover countries develop strategies and start investing

Smart cities 2.0 stage: governments of late-mover countries such as Asian countries start investing significantly in smart cities



CAGR

Asia	**32%**
Middle East and Africa	**6%**
North America	**22%**
Europe	**26%**
Latin America	**5%**

2006
Singapore defined its "Smart Nation" strategy as a leading-edge strategy for economic and social development.

2009
Japan developed the citizen-driven "i-Japan Strategy 2015".

2010
The Europe 2020 strategy was proposed, which emphasized three key priorities namely smart, sustainable and inclusive growth.

2010
China launched its smart city development plan, designating Wuhan and Shenzhen as the pilot cities in the smart city program.

2011
The Netherland's Amsterdam Smarter City Initiative seeks to achieve sustainable living and transportation.

2013.10
The China Smart City Industry Alliance was established under the Ministry of Industry and Information Technology of China. During the 12th Five-year Plan, the total investment in the smart city program in China amounted to RMB500 billion.

2015
The US government proposed a new smart city initiative which actively planned the design of smart transportation, smart grids and smart broadband with an investment of USD160 million made to promote the smart city program.

2015
India planned to develop 100 smart cities through PPP. The Indian government announced that an investment amounted to approximately USD7.5 billion would be made in the construction of smart cities in the next five years.

2015
The South Korean government planned to invest USD350 million to develop an IoT ecosystem with interlinked smart devices between 2016 and 2019.

2016
Vietnam made tremendous efforts in supporting industries related to the smart city. An amount of USD2.94 million had been invested in Kien Giang Province alone.

Source: public information from governments of different countries, Navigant, Deloitte Research

The emergence of smart cities has addressed these challenges to some extent. Their worldwide deployment has provided actual benefits to all cities, including increased GDP, lowered unemployment rate, improved quality of life and enhanced safety and health, enabling urban managers to achieve scientific decision-making, perform detailed management, react responsively and enhance the city's competitiveness.

Cities that invest in smart technologies and infrastructure managed to lower the unemployment rate by

1.0%

According to statistics, investing in smart grid and infrastructure promotes GDP growth rate by

0.7%

According to statistics, the office occupancy rate in cities that invest in smart grid, technologies and infrastructure would be increased by

2.5%

According to statistics, every 20% increase in ICT investments could promote GDP growth by

1.0%

Urban energy

The Amsterdam smart city helped the city save 9-14% of the fuel cost, and carbon emission is expected to reduce by **40%** by 2025.

Urban water

Barcelona's smart water system saves the city **USD58 million**annually.

Urban mobility

Barcelona's smart parking system saves the city **USD50 million** of parking cost annually.

Smart housing

In New Songdo City in South Korea, the smart building solution saves approximately **30%** of energy consumption for each building.

Other sectors

Xiamen's three-dimensional panoramic system reduces the occurrence of "information silo" phenomenon and saves **RMB10 million** of operation and maintenance costs annually.

Success factors

Transparent and collaborative government

Seamless integration of all types of analytical data using sensor network

Effective application of ICT technology and cognitive technology

Citizens' understanding on the smart city concept and application of smart instruments

Potential social benefits generated by smart city solutions

- Co-creation of decision making, new forms of governance such as digital democracy and participatory government
- Data driven policy making will increase the effectiveness of policy and create a more favorable social environment for businesses and people's life.
- Real-time analysis of surveillance data using sensor system can improve public safety and security.
- Increase waste collection efficiency using sensors in waste containers
- People who need care can live in their own home longer through sensoring and healthcare robotics.
- More efficient waste collection due to sensors in waste containers
- Lower urban congestion and pollution through optimizing the transportation infrastructure
- Better diagnostics and personalized treatment through artificial intelligence (AI) and big data analysis
- Energy savings through real-time insight in energy usage
- Lower congestion and pollution through optimal use of transportation infrastructure (roads, parking places)
- Analysis of data can detect water distribution network leakages in a timely manner and enhance water utilization

Source: Smart City Council, Deloitte Analysis, TMT forum, Huawei GCI, Deloitte Research

Today, there are over 1,000 smart city projects ready or under construction worldwide, where Europe, North America, Japan and South Korea are the leading regions in smart city development. In terms of number of smart city projects under construction, China is ranked first with its 500 pilot cities. They have also formed numerous smart city clusters in the Yangtze River Delta and Pearl River Delta.

Figure: Number of smart cities under construction in the world

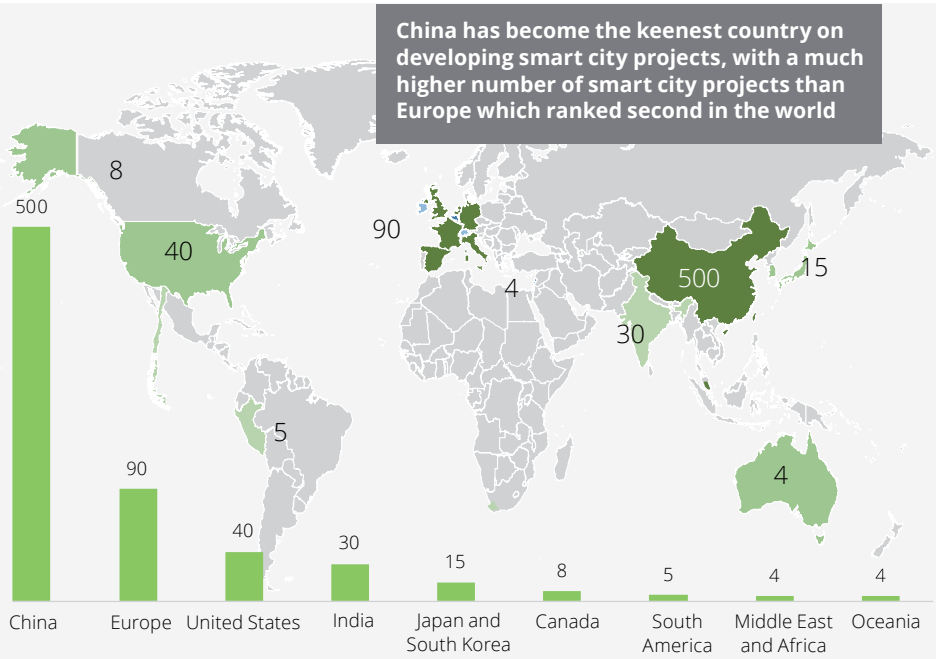
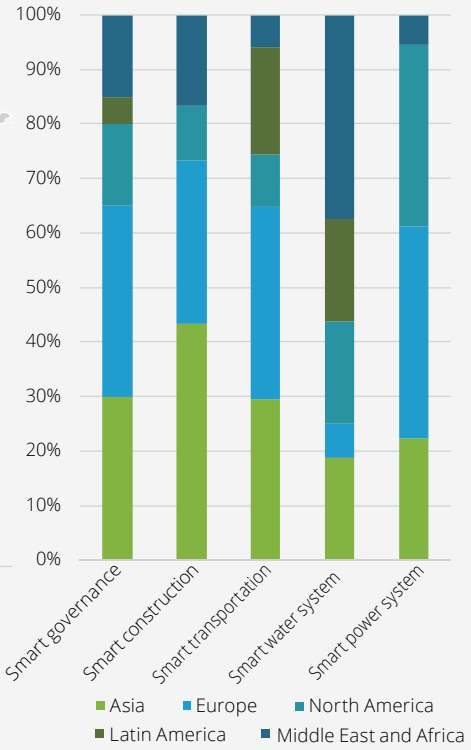


Figure: The proportion of smart city projects under construction among regions worldwide



Source: public information from the Chinese government, public information from the Indian government, public information from US White House, public information from the European Union, Smart City Council, Navigant, Deloitte Research

China has included the smart city initiative in their national strategy and has made significant investments in these projects. Both mega, tier-one cities and small and medium cities are home to smart city projects and they have formed numerous large smart city clusters across the eastern coastal area as well as the central and western regions of China.

Figure: Development of the smart city policy in China

Dec 2012
The Provisional Administrative Measures for National Smart City Pilot Program set out the eligibility for enrolling in the national smart city pilot program. Application submission period commenced.

Jan 2013
MOHURD announced 90 cities as the first batch of national pilot smart cities after a series of processes including submission of application by local cities, screening by provincial housing and urban-rural development administrative departments, and comprehensive review by experts.

Aug 2013
MOHURD announced 103 cities (districts, counties and towns) as the second batch of national pilot smart cities. In addition to the first batch of 90 pilot cities, the total number of national pilot smart cities reached 193.

Apr 2015
MOHURD and the Ministry of Science and Technology announced the third batch of national pilot smart cities, confirming 84 cities (districts, counties and towns) as national smart cities. The total number of national pilot smart cities reached 300.

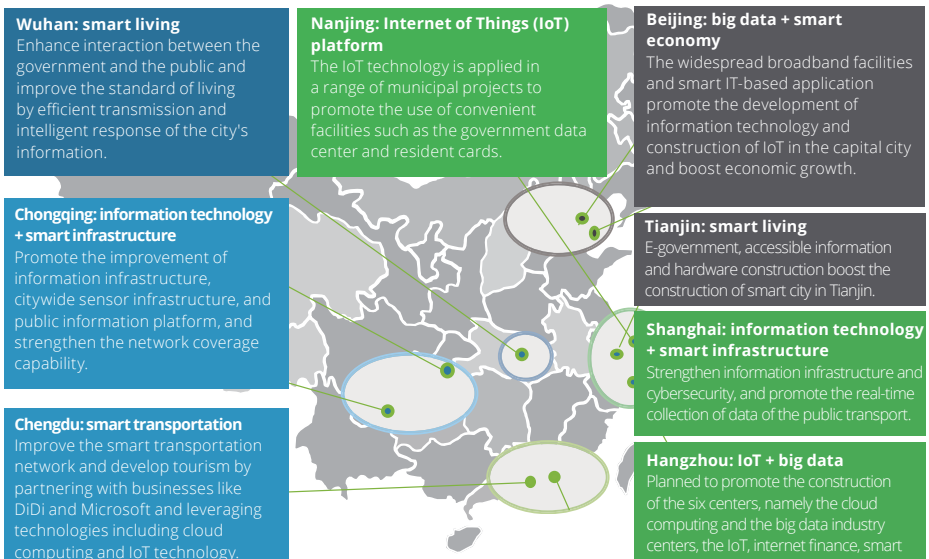
2016
The state proposed a new style of smart cities and started on the self-assessment exercise on the new-style smart cities.

During the 13th five-year plan period, efforts will be stepped up to promote the construction of smart cities in 100 cities. The overall scope of investment planned will reach RMB500 billion.

The people-centered approach to building a smart society was introduced for the first time in the report to the 19th CPC National Congress.

The smart society emphasizes the promotion of people-centered sustainable innovation based on new network facilities, new data environment, new ideas and models, and new technology application with an aim to offer the people a greater sense of fulfilment and happiness.

Figure: Distribution of major smart cities in China



Wuhan: smart living
Enhance interaction between the government and the public and improve the standard of living by efficient transmission and intelligent response of the city's information.

Nanjing: Internet of Things (IoT) platform
The IoT technology is applied in a range of municipal projects to promote the use of convenient facilities such as the government data center and resident cards.

Beijing: big data + smart economy
The widespread broadband facilities and smart IT-based application promote the development of information technology and construction of IoT in the capital city and boost economic growth.

Chongqing: information technology + smart infrastructure
Promote the improvement of information infrastructure, citywide sensor infrastructure, and public information platform, and strengthen the network coverage capability.

Tianjin: smart living
E-government, accessible information and hardware construction boost the construction of smart city in Tianjin.

Shanghai: information technology + smart infrastructure
Strengthen information infrastructure and cybersecurity, and promote the real-time collection of data of the public transport.

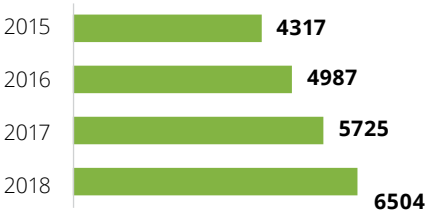
Chengdu: smart transportation
Improve the smart transportation network and develop tourism by partnering with businesses like DiDi and Microsoft and leveraging technologies including cloud computing and IoT technology.

Hangzhou: IoT + big data
Planned to promote the construction of the six centers, namely the cloud computing and the big data industry centers, the IoT, internet finance, smart logistics, and digital contents industries.

Shenzhen: IoT platform
The smart IoT platform in Shenzhen links up different sectors including transportation, logistics and community life.

Guangzhou: smart transportation
The smart transportation sensor platform covers core districts, primary and secondary trunk roads, and city entrances and exits to achieve real-time monitoring and control on the passenger traffic volume and flow at passenger transportation hubs.

Figure: Market size in smart cities in China (RMB100 million)



As of June 2016, 95% of cities above the sub-provincial level, over 76% of prefecture-level cities and over 500 cities in China specifically proposed to build or were in the process of building smart cities. Smart education, urban safety and social security information will become the focus of construction in the future.

Source: public information from the central government and local governments of China, OFweek, Deloitte Research

In recent years, the number of pilot smart cities in China exhibited linear growth. Most of the cities and regions chosen as the national pilot smart cities are located in the city clusters in the coastal areas of the Yellow Sea and the Bohai Sea and the Yangtze River Delta. In addition, the smart construction in provinces and municipalities/cities with more approved pilot projects are at the leading edge.

Figure: Growing number of smart cities in China

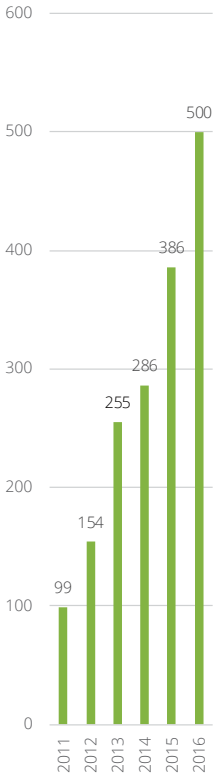
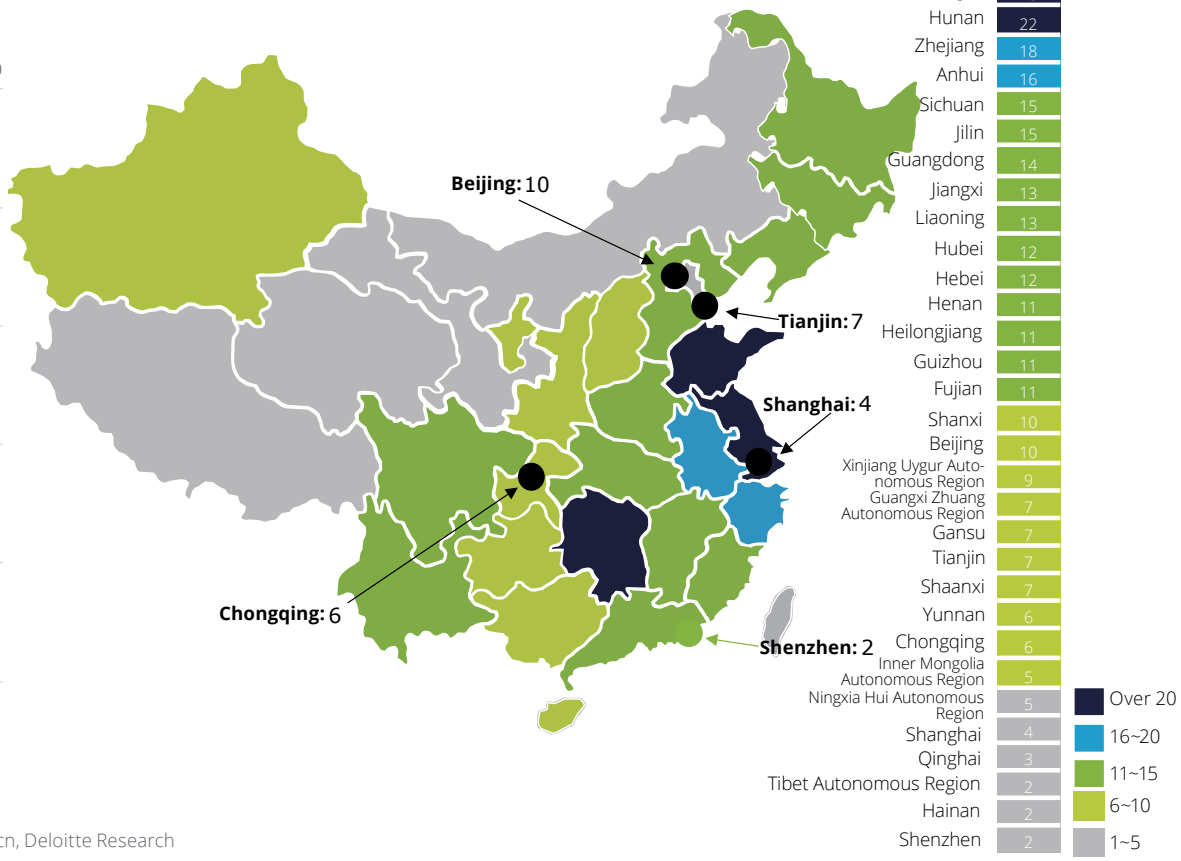


Figure: Distribution of pilot smart cities in China

Note: Incomplete statistics; data of selected major cities only



Number of pilot smart cities

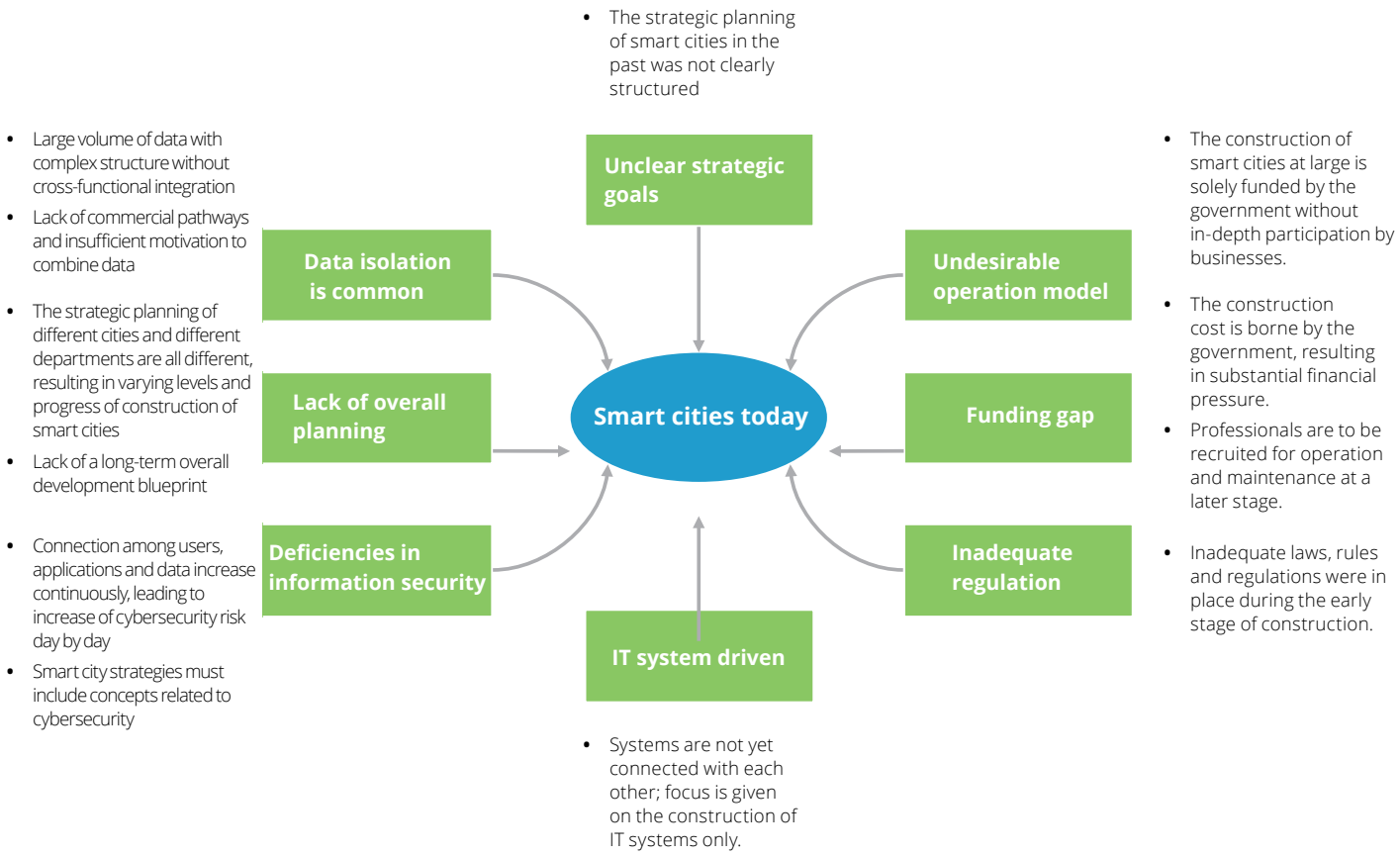
Shandong	30
Jiangsu	28
Hunan	22
Zhejiang	18
Anhui	16
Sichuan	15
Jilin	15
Guangdong	14
Jiangxi	13
Liaoning	13
Hubei	12
Hebei	12
Henan	11
Heilongjiang	11
Guizhou	11
Fujian	11
Shanxi	10
Beijing	10
Xinjiang Uygur Autonomous Region	9
Guangxi Zhuang Autonomous Region	7
Gansu	7
Tianjin	7
Shaanxi	7
Yunnan	6
Chongqing	6
Inner Mongolia Autonomous Region	5
Ningxia Hui Autonomous Region	5
Shanghai	4
Qinghai	3
Tibet Autonomous Region	2
Hainan	2
Shenzhen	2

Over 20
16~20
11~15
6~10
1~5

Source: zhihuichengshi.cn, Deloitte Research

Despite the good momentum of development, most of the "smart" cities today are not truly "smart" in one sense. From the perspective of multiple dimensions including strategy, design, construction, operation and maintenance, there are a number of deficiencies to prevent a city from unleashing the value and potential it would truly gain after the smart transformation.

Figure: Challenges faced by smart cities today



Source: public information from the government, Deloitte Research

As the Chinese government became aware of these key problems and deficiencies, in their 13th five-year plan, they further proposed new requirements and new goals for the construction of a new style of smart cities; implementation of new urbanization planning; and construction of smart cities with Chinese characteristics which articulate the new policies and mechanisms and innovative development approach.

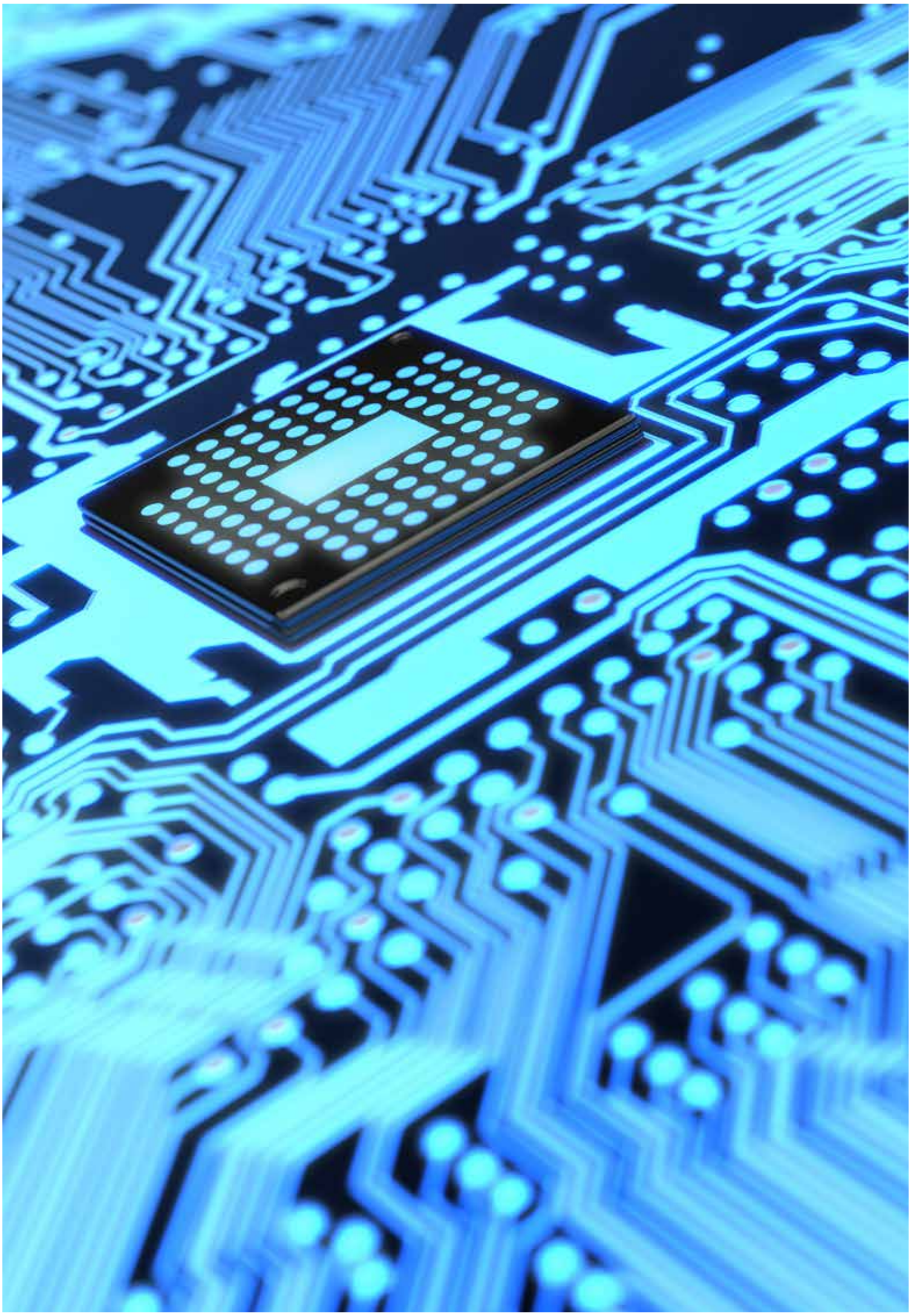
Three features of the new-style smart cities

- **Openness, contribution and sharing**
  The government will have to make data and smart city planning open for the public to gain a better understanding on the overall planning of the government and to express opinions in order to achieve social consensus.
- **More equitable access to services**
  The services provided in smart cities in the past favored users with better IT capabilities. In the new-style smart cities, information gap will be eliminated to the largest possible extent to help disadvantaged communities with lower IT capabilities enjoy public services.
- **More distinctive characteristics**
  As the construction and development of smart cities stem from large cities, the development of information technology in small and medium cities cannot be replicated in its entirety. The construction of the new-style smart cities will promote the construction of cities with distinctive characteristics, and promote the diversified development of regional economy through distinctive projects such as the building of distinctive small towns.

Five goals of the new-style smart cities

- **Improve quality of life**
  To construct a smart public services system with an aim to achieve data opening, sharing and integration with respect to information on smart public services including healthcare, employment, public security and education.
- **Improve governance efficiency**
  To leverage information and data in urban management, promote the modernization of the urban governance system by means of information technology and build a unified urban data platform.
- **Opening and integration of data**
  To build a data resources sharing platform for government information with an aim to break down the data barriers among different sectors such as education, transportation and economy to achieve interconnectedness of data.
- **Develop green economy**
  To build a sustainable green ecosystem to achieve coordinated development of the economy and areas such as environmental protection and energy management.
- **Improve cybersecurity**
  To ensure the security of transmission of information and data by leveraging next generation technology as networks including the government internet, public internet and IoT are becoming interconnected.

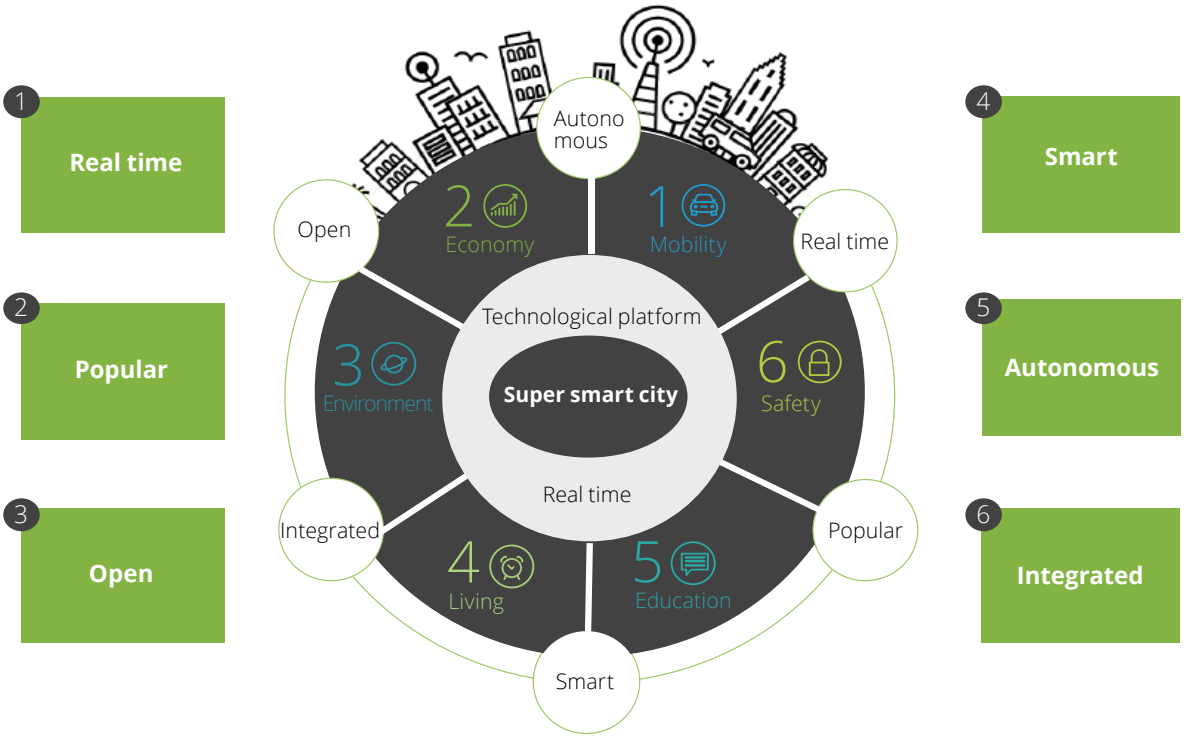
Source: public information from the government, Deloitte Research



Super smart cities in the future

We believe that in the future, the traditional smart city will develop into the super smart city, which is the enhanced version of the former one and composed of six key elements covering six sectors. The super smart city features a higher degree of integration, better collaboration and value maximization.

Figure: An ideal super smart city



Source: Deloitte Research

Compared to traditional smart cities, new-style super smart cities cover six sectors going beyond the traditional construction of smart cities, making better use of AI and data, and relying more on smart decisions to reduce human intervention and enable different sectors to be more open and integrated.

Smart economy

Advanced technologies help cities streamline government procedures, such as approval and licensing. Digitization and big data analytics can improve urban managers' capability in tracking performance and outcomes.

Smart environment

Sensors detect leakage to preserve natural resources, such as water. Responsive devices (e.g. washing machines) will stop running temporarily when energy demands (or prices) go up. Cities use behavioral economics and game mechanics to encourage positive resourcing decisions.

Smart living

By promoting connected communities through smart buildings and health care innovation, and the use of data to monitor and enhance social activities, the quality of life and sustainability of cities can be enhanced.

Smart mobility

Shared mobility, autonomous driving, dynamic pricing, IoT, and advanced analytics enable people and things to move faster, safer, cheaper, and cleaner.

Smart safety

Drones, wearable computing, facial-recognition, and predictive video help law enforcement fight crime and maintain public safety. Agencies pre-empt crimes by tapping into all streams of data including social and crowdsourced data. Secure data platforms, clear governance and smart access protocols help ensure that data is safeguarded against cyber threats.

Smart education

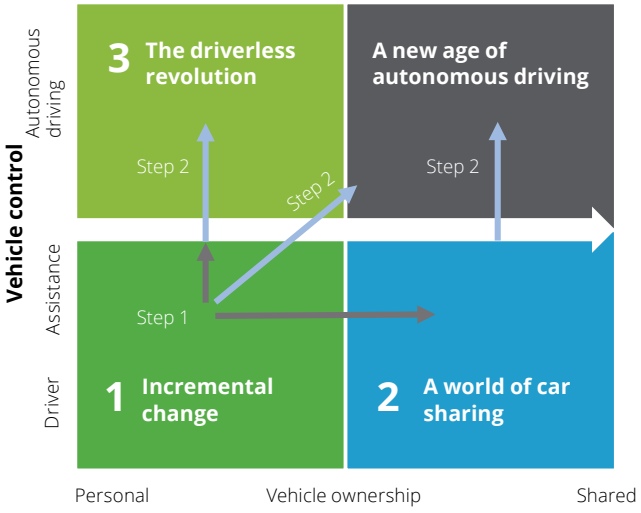
Virtual learning, digitalization and augmented reality transform the learning approach. Unbundled, personalized, and blended education is more accessible and augmented by rich data and analytics. The focus shifts from digital contents in the classroom to real-world experiential learning.

Source: Deloitte Research

In transportation and mobility, autonomous driving and shared mobility will coexist in super smart cities and ultimately be integrated with smart traffic control and parking systems to achieve automated mobility.

Autonomous driving revolution

Figure: Mobility scenarios in super smart cities



Private or shared ownership:

- it depends on personal preference and financial conditions
- the higher the level of shared ownership, the higher the asset efficiency of the whole system is

Smart transportation revolution

Smart parking system

- Finding a parking space in a large city is still difficult. Smart solutions can be used to optimize the use of parking spaces. Each parking space is equipped with a sensor that detects whether a car is parked on it or not. Drivers will be offered with real time information on the nearest parking spaces and their prices. This eliminates the need for driving around looking for a parking space. Furthermore, if there is no parking space at all at destinations, drivers can decide to change their plans and look for other options (e.g. other time, public transport).
- Parking spaces of individuals or businesses are often used only part of the time. Outside office hours, there is a great potential for making additional parking spaces available through smart solutions, based on an online reservation system. This allows new forms of partnerships, e.g. by making the parking space of a business available for visitors at weekends or in the evenings.

Smart traffic control

- Real time and fine grained data of the traffic flow in the city, created by sensors in infrastructure and vehicles, allow intelligent transportation systems to optimize the traffic flow by adjusting traffic lights and other signals.
- The smart traffic control system can also be used to guide emergency services like ambulances smoothly through the traffic by finding the fastest route, keeping bridges closed and adjusting traffic lights.

Social value

- Guarantee safety, lower congestion and reduce traffic accidents
- A more convenient, greener and economical mode of transportation
- Optimization of the existing transportation system and creation of a brand new transportation system
- Drive the transformation and upgrading of transportation related industries
- Develop capabilities in resource allocation optimization, public decision-making, industry management and public services

Source: Deloitte Research

A sound smart safety system is also an indispensable foundation of super smart cities. Safety systems in the future will integrate all resources to build an integrated monitoring network and achieve resource sharing among all departments to predict and respond to various emergencies in real time.

Based on smart hardware and software, smart safety systems provide citizens with a safer and more comfortable environment to live in

Smart safety hardware

Smart street lighting

- Reduce energy consumption
- Become brighter when movement is detected
- Indicate when an ambulance or fire truck drives through (e.g. by changing the color of the light), which could shorten transit time

Smart cameras

- Monitor public safety in real time and change the traditional use of cameras in subsequent investigation and evidence collection
- Capture facial features for facial recognition to help the police find suspects promptly

Drones

- Send images to assess the danger before sending rescuers in the rescue scenes
- Help rescuers detect fire and heat, and help the police quickly search accident and crime scenes

Smart safety software

Smart prediction

- Data analytics, combined with real-time facial recognition and identification scanning, can be used to predict the specific time of a crime
- Analysis results can be used to focus police officers patrols to areas with high likelihoods of crime

Crime fighting

- Big data analysis can be used to determine the most likely causes of increased prevalence of crime in certain areas
- Analysis results can be used by governmental agencies to target campaigns specifically on those neighborhoods and causes
- Prevent recidivism

Emergency apps

- Smart apps can be used to send an alert in case an emergency, either medical or criminal, happens
- The apps automatically detect the locations, possibly augmented with audio or video recorded by the application
- The smart solution connected to the app notifies the nearest safety guards/police officers or the police station

Social value

- An urban safety system capable of automated sensoring, adaptation and judgement
- Provide effective early warnings on irregular situations and prevent crimes in advance; accept commands with proactive defense and offer comprehensive information review
- Achieve the online tracking and positioning of targets, display the overall information in a comprehensive and multi-dimensional way, making commands and controls more intuitive and efficient
- Cover public safety, transportation management, firefighting, criminal investigation for urban emergencies, smart transportation, green buildings, government supervision, environment monitoring, emergency command, disaster control, etc.

Safeguarding

- When building smart safety systems, cities should also prevent issues caused by cyber attacks, including invasion of monitoring systems, leakage of citizens' privacy, and threats to public safety.

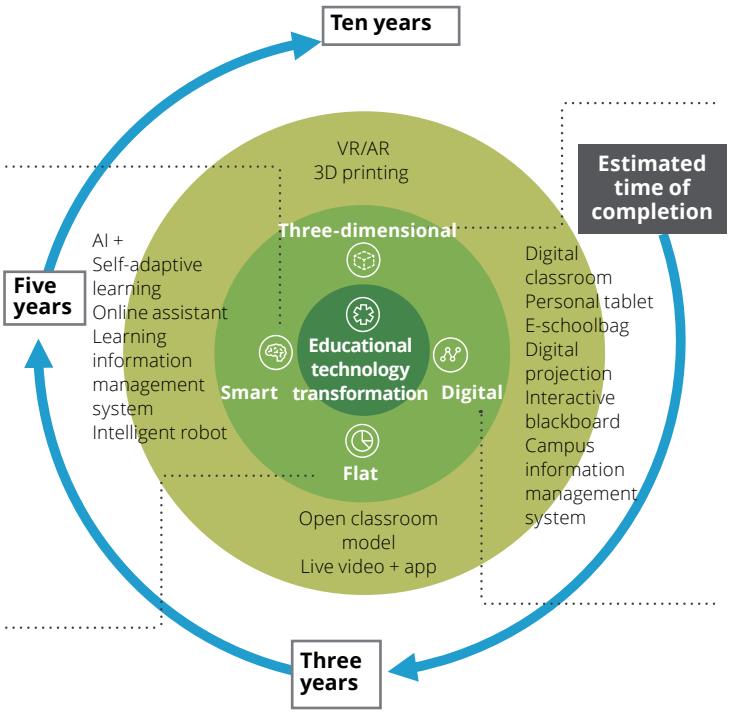
Source: Deloitte Research

In super smart cities, digital transformation will take place in the education sector with the application of a vast amount of digital devices to enhance the smart development of learning, making it more self-adaptive, open and personalized and allowing for lifelong learning.

New technologies transform the education sector to highlight the trend towards smart, flat, digital and three-dimensional education

- The development of AI technology is the core
- Combine with the five learning parts: teaching, learning, practice, assessment and test
- Use image and voice recognition functions to analyze issues and generate personalized solutions and feedback through deep learning, self-adaption and computing of data
- Technologies are subject to further advancement to meet the standard of large-scale commercial use

- Leverage Internet technologies and video broadcasting technologies to connect offline and online learners, allowing the direct delivery of learning resources from suppliers to learners, and reducing the layers of resource circulation
- With mature technologies and relatively low costs, it is expected that essentially all learners will be covered within three years



- Make flat knowledge vivid, three-dimensional and sensible
- Achieve through technologies including VR, AR and 3D printing
- In the K12 segment, it is hard to closely integrate specific technologies with knowledge due to high technical costs, which hinders extensive promotion

- Technological advancement on traditional education institutions by the Internet technologies relies on the cooperation between the two sides
- Two main scenarios including the replacement of traditional teaching tools in class and parent-school communication methods by digital products, and the change in extracurricular learning materials and methods with digital equipment
- Inside schools, advances in hardware facilities are expedited by government support, whereas development outside schools is driven by Internet businesses, resulting in gaps within and outside of the classroom and between technologies and contents

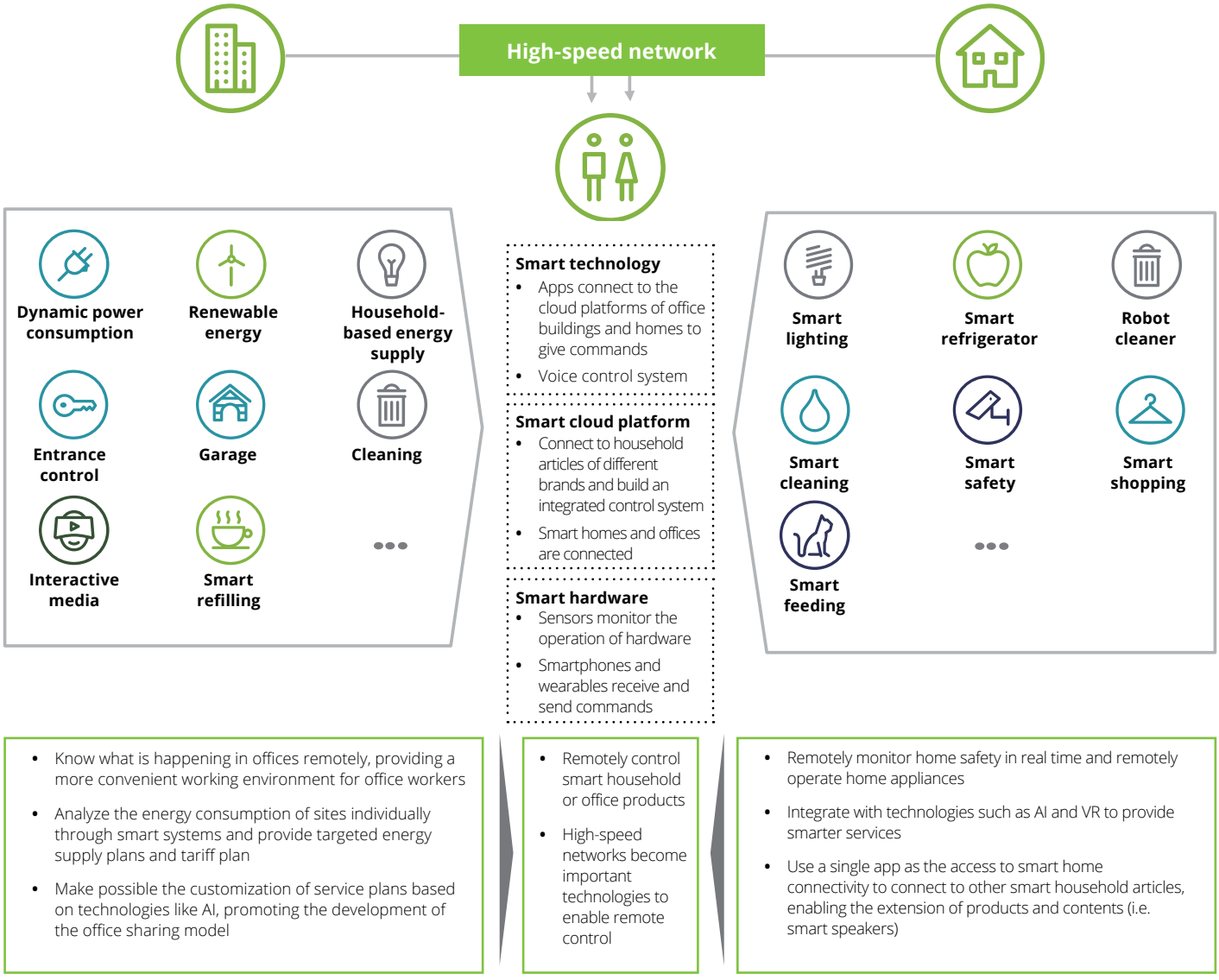
Social value

- The education sector will continuously be transformed by new technologies, therefore it will reshape the correlation among all parties in learning and improve the educational efficiency and the level of large-scale education
- The availability of quality education resources will be enhanced, which will optimize the allocation of education resources, promote equity in education and drive the development of lifelong education

Source: Deloitte Research

High-speed networks connect homes with offices, enabling ubiquitous sensors to better improve the quality of living and work, and create a smarter way of life and work.

Smart homes and offices are connected through high-speed networks



- Know what is happening in offices remotely, providing a more convenient working environment for office workers
- Analyze the energy consumption of sites individually through smart systems and provide targeted energy supply plans and tariff plan
- Make possible the customization of service plans based on technologies like AI, promoting the development of the office sharing model

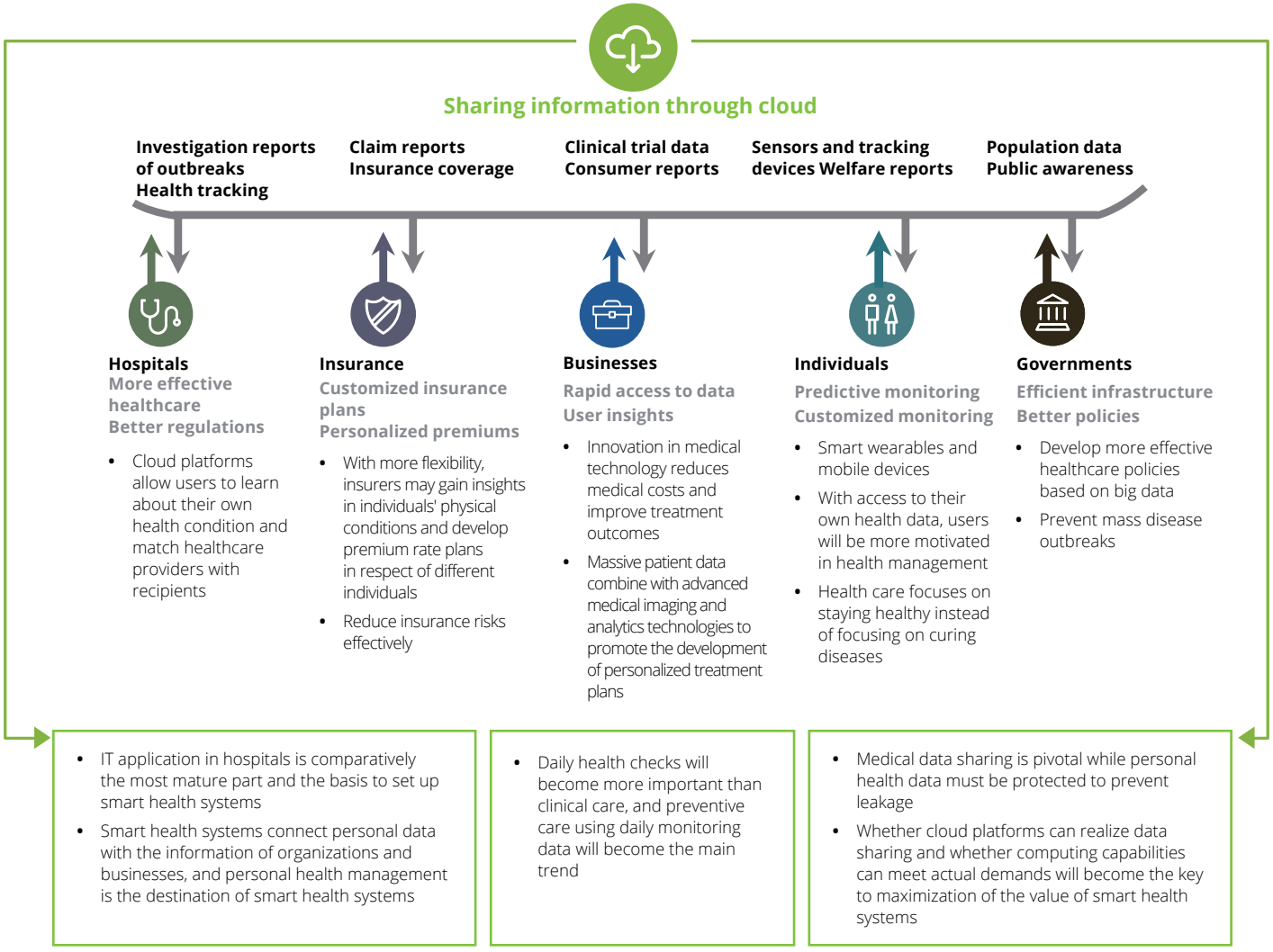
- Remotely control smart household or office products
- High-speed networks become important technologies to enable remote control

- Remotely monitor home safety in real time and remotely operate home appliances
- Integrate with technologies such as AI and VR to provide smarter services
- Use a single app as the access to smart home connectivity to connect to other smart household articles, enabling the extension of products and contents (i.e. smart speakers)

Source: Deloitte Research

Under the smart health system, data has become an important medical resource. Information in hospitals and personal health data acquired from personal smart terminals are interconnected through cloud platforms. Shared data plays a valuable role in the healthcare sector, which serves as a basis for different parties to provide personalized health services for users.

Participants in the healthcare industry access shared information through cloud platforms



Source: Deloitte Research

The setup of smart environment systems is still in the early stage. Government departments will become the main force, and the use of big data to analyze data sources from the public will become an important means for environment management.

Smart environment systems cover all aspects of resource utilization

Smart water system

Minimize waste and secure water quality

Water leakage detection
Pollution detection
Advanced warning for flood

Smart waste system

Improve waste disposal efficiency

Sense the status of waste containers
Inform garbage trucks that they are filled with wastes

Smart energy system

Greener energy development, lower energy consumption, flatten energy consumption peak and off-peak curves

Distributed power stations with renewable sources (e.g. wind and solar power)

Smart grids

- Monitor energy usage whilst transmitting energy
- Regional grids reduce energy consumption

Smart metering

- Allow price differentiation at different times to flatten energy consumption curves
- Encourage users to change their habits to reduce energy consumption

Responsive devices

- These responsive devices (e.g. washing and drying machines) temporarily stop running when the demand for energy or price increases

Thermal energy use

- Collect and store thermal energy in summer for use in winter
- Use heat generated by other devices

Cooperation in energy markets

- Cooperation between companies and governments is required to develop regulations
- Cooperation between companies is required to develop new technologies

Important supporting measures

- Big data has become an important technical support for building smart environment systems to break down existing smart barriers and promote the cooperation and data sharing among different departments
- Data generated by the public has become a significant source to support smart environment systems
- Portals including governments' environmental protection websites and new types of social media will become an important component of smart environment systems and create synergies with monitoring systems that directly connect to businesses

Still in the early stage

- It is hard to obtain effective data sources to be analyzed by big data with a lack of a consistent data review and alignment mechanism
- Collection and feedback of massive data cannot be completed by staff from government environmental departments
- It is difficult to build precise data model with a lack of professionals in developing smart environment systems

Source: Deloitte Research

Smart economy and governments use disruptive technologies and data to innovate in all parts of the value chain, including the entire policy implementation process involving problem perceiving, policy-making, execution and subsequent feedback

Areas in the IT transformation of governments

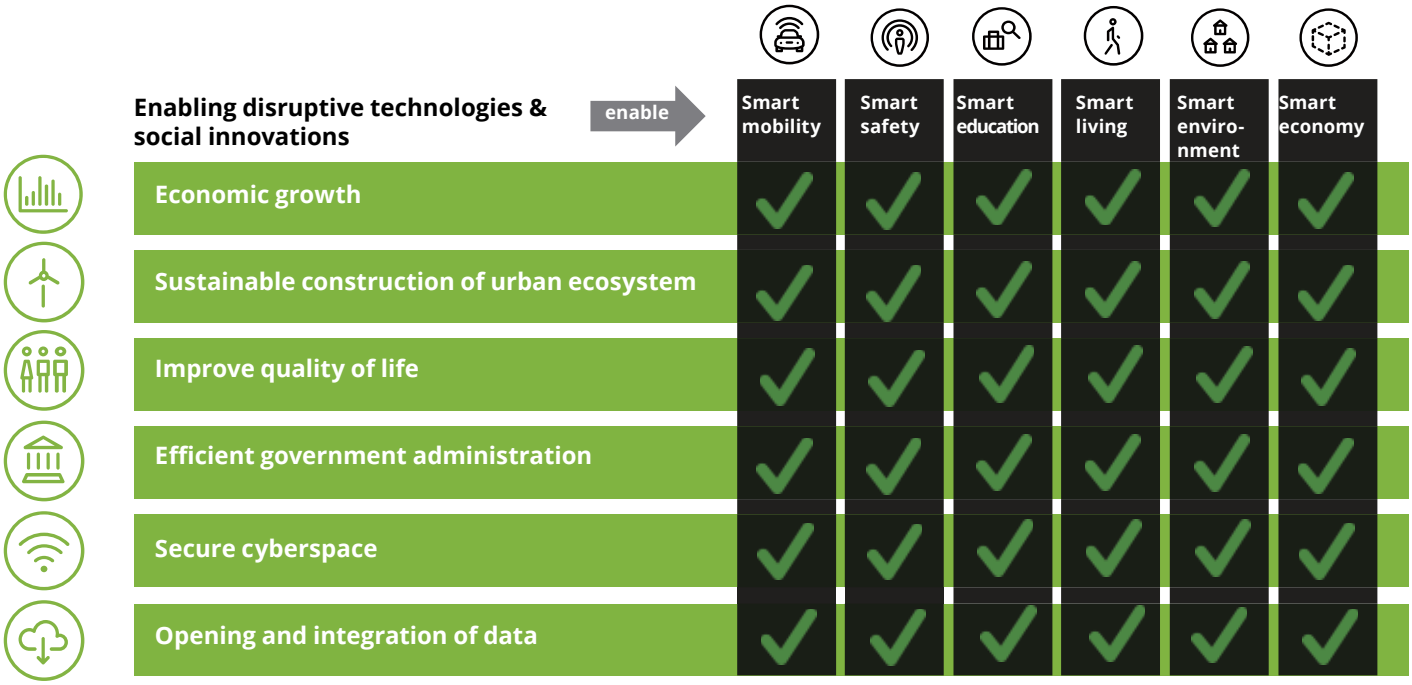
Perceiving of social and economic problems	Policy-making	Execution	Subsequent monitoring
Government policies start with analysis of social and economic problems in a fact-based way; The availability of big data combined with advanced data analytics techniques increases the predictive power of these analysis	The policy-making process becomes more complex due to increased transparency, competition in the analyses combined with new types of digital democracy and co-creation; more effective policies due to relevant feedback and creative alternatives at earlier stages in the process	Use information technology, communication technology and network technology to transform the traditional government administration and public services; execution in businesses and the public should be differentiated	Monitoring the outcomes of policy implementation will remain to be data-based

Specific measures:

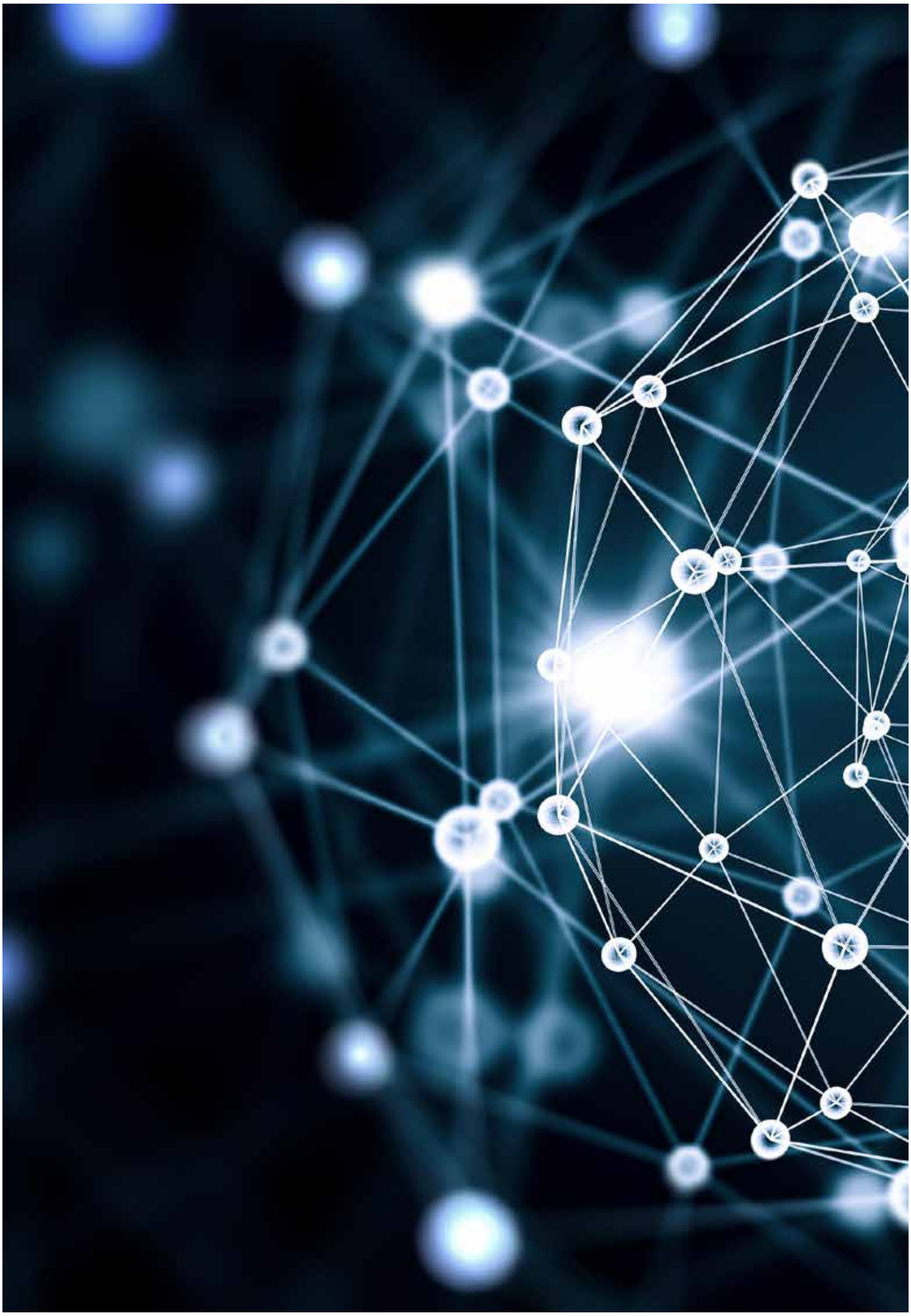
- Provide more ways for connectedness between governments and the public, such as communicating governments' new policies to the public through online government platforms and mobile APPs
- Online windows: the progress of digitalization of business processes is apparently faster than processes related public services, and many convenience services cannot be completed via the Internet, such as visa application and renewal outside the home country
- One-stop process: the public still need to go to different places for different matters

Source: Deloitte Research

Six major sectors: these sectors are interwoven and goal-oriented. In the future, people in super smart cities will get used to the foresaid scenarios although none of the cities today have made the dreams of such smart services come true yet.



Source: Deloitte Research

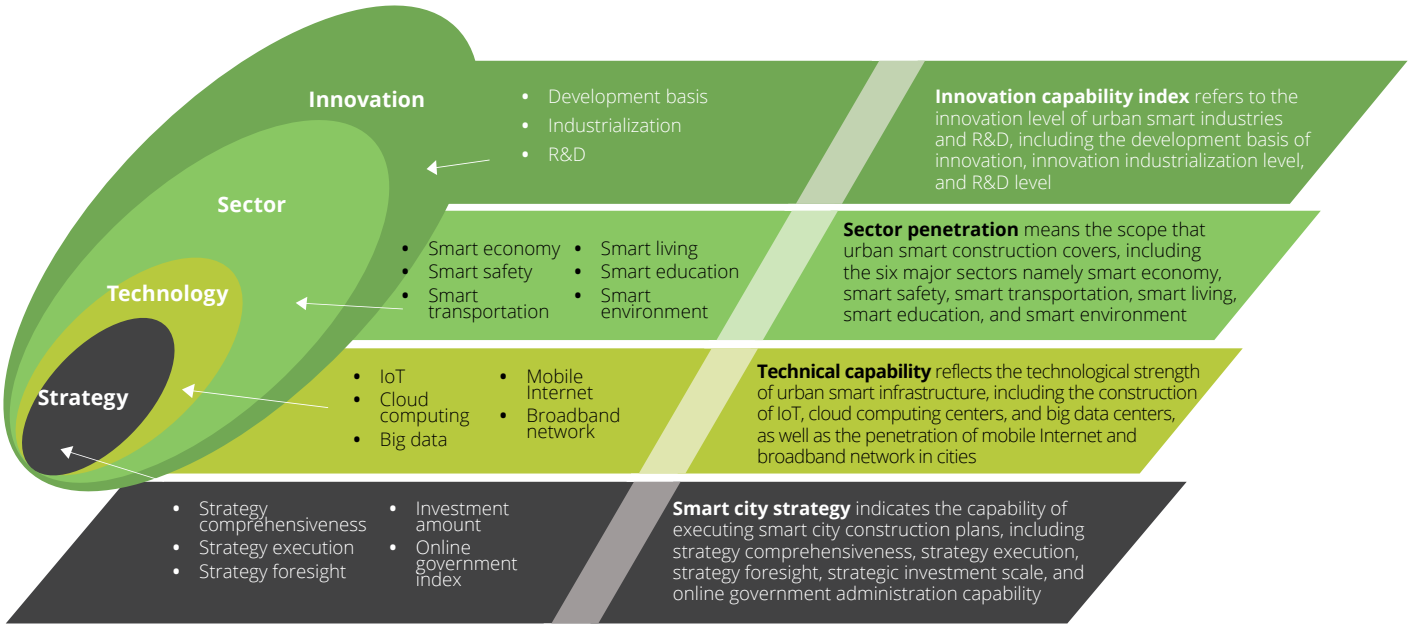


China super smart cities index

A super smart city can be evaluated based on four dimensions: first, whether there is long-term strategic planning; second, whether there is sufficient support from technology infrastructure; third, whether it is smart enough in terms of depth and breadth; fourth, whether it is capable of sustainable innovation.

Research objectives

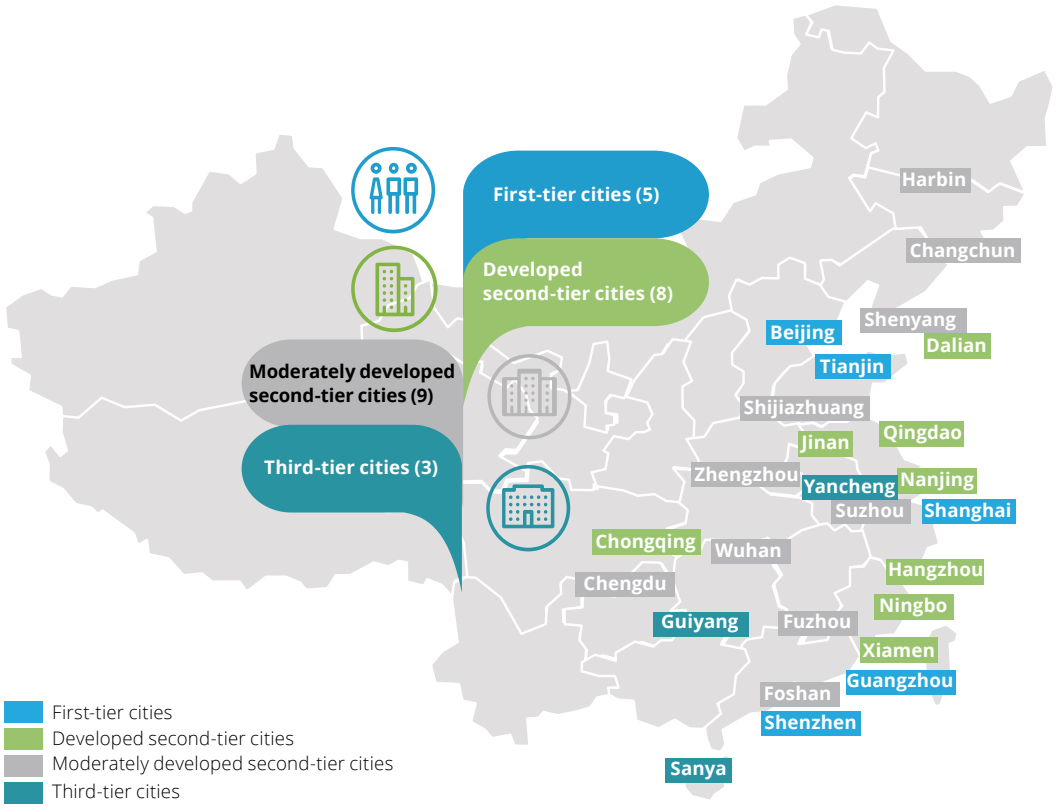
- The super smart cities index is designed to gain an overview of the current trends in smart city construction and the future development planning, and provide Deloitte's global insights to guide cities for a shift of focus from infrastructure construction to the application level
- We think that cities are not necessarily smart in its full sense. The local governments should develop smart cities with their own characteristics based on their own needs, and by doing so to leverage smart city projects to facilitate economic and social development and build a happy society with higher quality of life



Source: Deloitte Research

Based on the four dimensions, we conducted a systematic analysis on 25 major cities to identify the development status of smart cities and determine the gap between these cities and super smart cities.

Figure: Distribution of smart city samples



Source: Deloitte Research

Selection criteria

- Most selected cities (including first-tier, second-tier, and third-tier cities) are located in eastern coastal areas and Central China. Due to stronger economic strength, eastern coastal cities are more capable of developing and executing smart city strategies. Such strategies are usually developed and executed by local governments.

First-tier cities with complete planning

- First-tier cities have more advantages in smart city construction and planning. However, due to large scale and more complicated interest relations, their execution force is slightly inferior to second-tier cities.

Second-tier cities closely follow or surpass first-tier cities

- With fewer policy barriers and smaller economic sizes, second-tier cities are more suitable smart city pilot destinations and can execute smart city strategies more efficiently than first-tier cities.

Differentiated third-tier cities

- Third-tier cities adopt differentiated approaches in developing smart cities: Guiyang and Yancheng focus on deploying smart infrastructure; Sanya stands out in developing smart tourism and smart environment.

Among the super smart city rankings, four first-tier cities rank top with absolute superiority in four core areas; 15 developed second-tier cities are in fierce competition; and cities in the third rank still have room for improvement.

Figure: Rankings of China's super smart cities

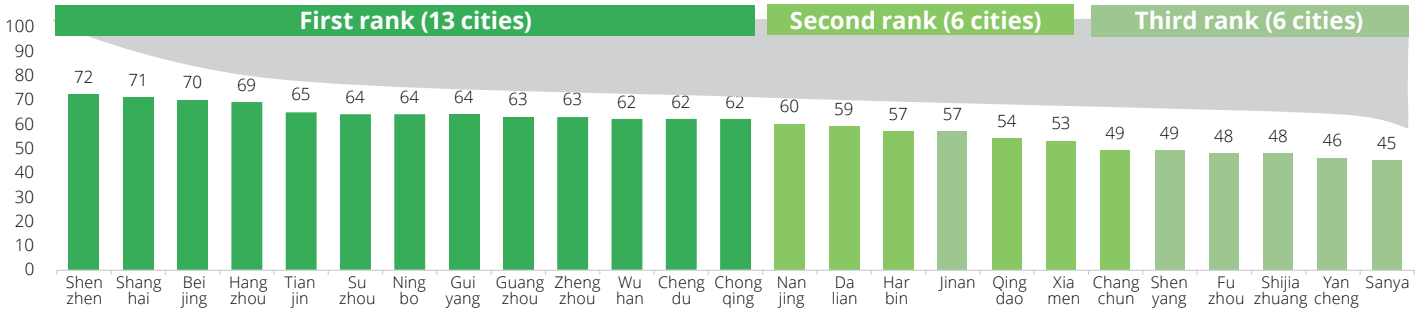
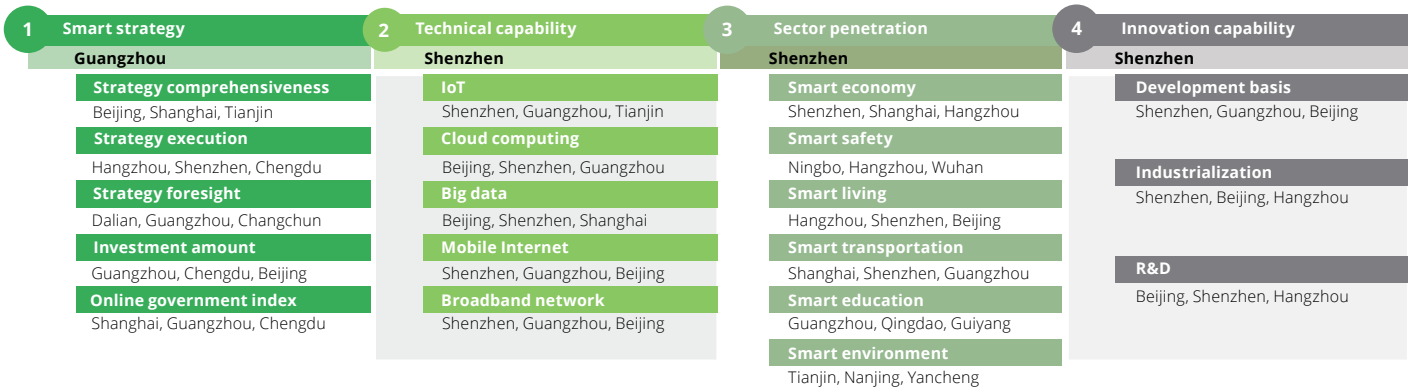


Figure: Super smart cities leading in four core areas

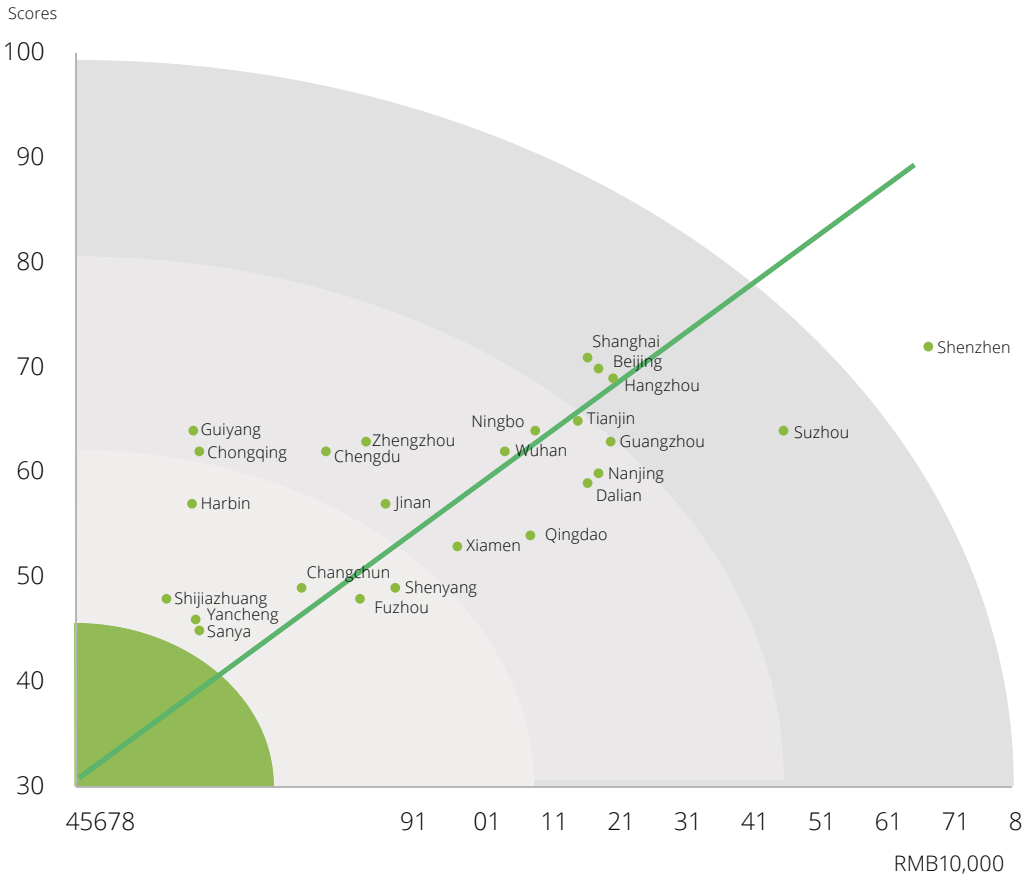


Source: China City Statistical Yearbook, websites of city governments,
Tencent Research Institute, Guangdong Academy of Social Sciences, Deloitte Research

In terms of economic development, smart development is driven by positive economic growth: cities with higher per capita wealth perform better in smart development. However, in many cases, smart development lags behind economic development, since cities only focusing on economic growth tend to ignore smart city construction.

City	Smart city ranking	Ranking of per capita GDP
Shenzhen	1	1
Shanghai	2	7
Beijing	3	5
Hangzhou	4	3
Tianjin	5	9
Suzhou	6	2
Ningbo	7	10
Guiyang	8	23
Guangzhou	9	4
Zhengzhou	10	16
Wuhan	11	12
Chengdu	12	18
Chongqing	13	20
Nanjing	14	6
Dalian	15	8
Harbin	16	24
Jinan	17	15
Qingdao	18	11
Xiamen	19	13
Changchun	20	19
Shenyang	21	14
Fuzhou	22	17
Shijiazhuang	23	25
Yancheng	24	22
Sanya	25	21

Figure: The relation between super smart city index scores and per capita GDP (RMB10,000)



- Significant positive correlations are found between smart city development and per capita GDP.
- But cities with lower per capita wealth can also build outstanding smart cities.

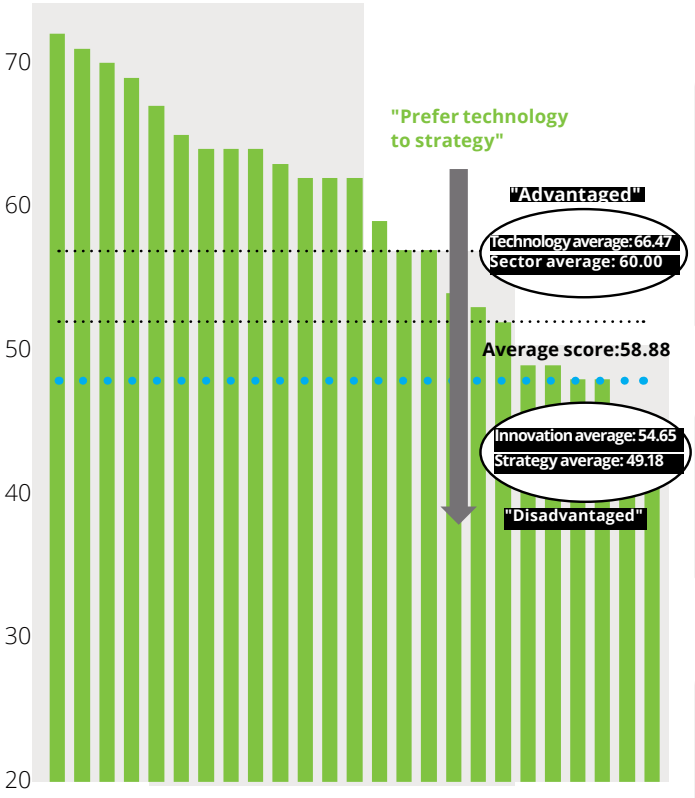
- On one hand, in cities with fast urbanization, large population, and medium-level per capita wealth like Shanghai, Guangzhou, and Ningbo, urban residents can enjoy smart city services.
- Meanwhile, cities like Harbin, Chongqing, and Guiyang perform better in smart city construction than in economic development.

- On the other hand, smart city construction in some places still lags behind economic development. And these cities tend to ignore smart city construction while improving economic growth, therefore, their rankings are relatively lower.

Source: Guangdong Academy of Social Sciences, China City Statistical Yearbook 2016, China Big Data Industrial Observation, Deloitte Research

In general, most cities have made progress in smart city construction, but still need to make further improvements. It is worth noting that domestic smart cities with well-developed technology infrastructure scored above average, but lagged behind in innovation and strategic planning.

Figure: Average scores of super smart cities in four core areas



Source: China City Statistical Yearbook 2016, websites of city governments, Tencent Research Institute, Guangdong Academy of Social Sciences, Deloitte Research

Technical capabilities are relatively stronger

- Thanks to favorable policies, China has accumulated certain experience in big data management and promoted the development of "Internet Plus". Data computing centers have sprung up in large and medium cities. Beijing, Shandong, Shanghai, Jiangsu, and Zhejiang have established over ten data centers respectively.
- Fiber to the home has already been widely applied in urban areas. As of 2016 Q4, 984 million people were using mobile broadband network (mainly referring to 3G and 4G), a significant increase in internet penetration.

Development gaps in the six major sectors are narrowed

- While Beijing, Shanghai, and Shenzhen have achieved the most balanced development, other cities have established different development structures in six core sectors.
- Small score gaps reflect that first-tier cities, municipalities, and provincial cities have made achievements in several core sectors.

Innovation advantages vary significantly

- First-tier cities, Yangtze River Delta region, and Pearl River Delta region have obvious innovation advantages, among which, Shenzhen and Beijing are China's innovation highlands.
- For central and eastern cities, weak development basis has led to little innovation, and traditional industries have limited the industrialization level.
- Second-tier cities are less attractive to talent than first-tier cities. The shortage of R&D talent has limited R&D capability and the expansion of sci-tech parks.

Most cities lack smart strategies

- "Preferring technology to strategy" has become the weakness of many cities. Forward-looking strategies and government investment amounts are the keys for making leading smart city construction strategies.
- In general, most Chinese cities have made overall strategic planning, but due to the lack of specific implementation plans and close collaboration between departments, they have not achieved desired results.
- Most cities have developed short-term (one to three years) strategies, but not long-term plans.

1

At core strategic level: cities in Central China rise suddenly and third-rank cities lack long-term and complete strategic plans for incomplete strategic planning. Smart city construction requires effective capital support and smart online city governments, and government investments and strategic foresights are the keys for building leading super smart cities.

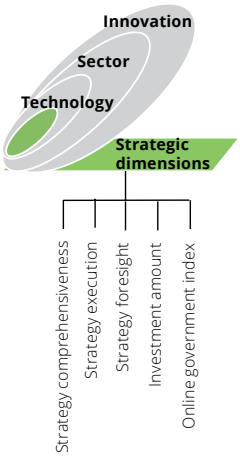
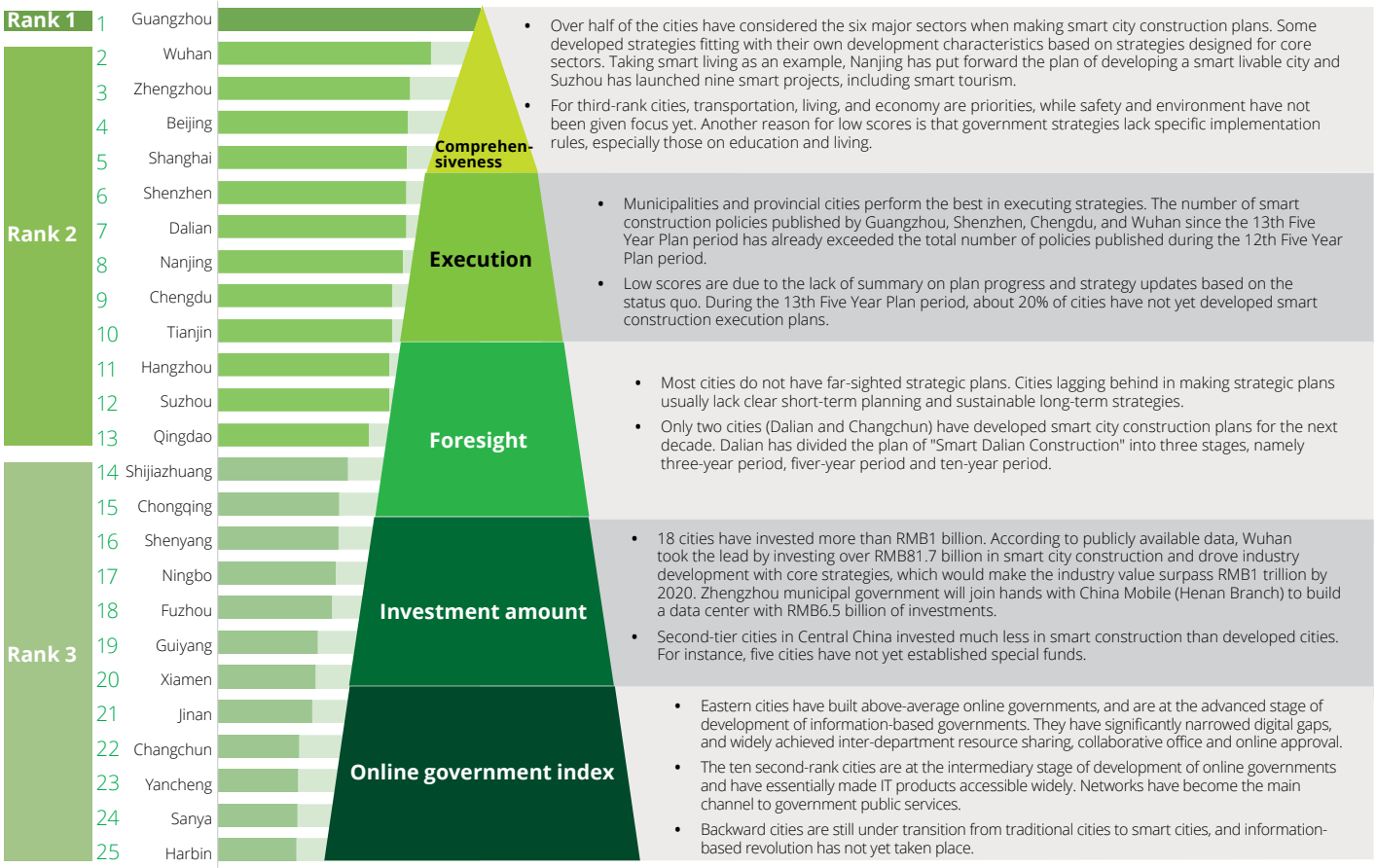
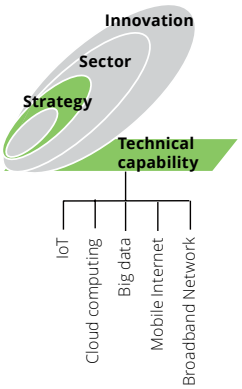


Figure: Rankings by strategic dimension



Source: city government websites, Tencent Research Institute, Chinanews.com, Wuhannews.net.cn, Deloitte Research



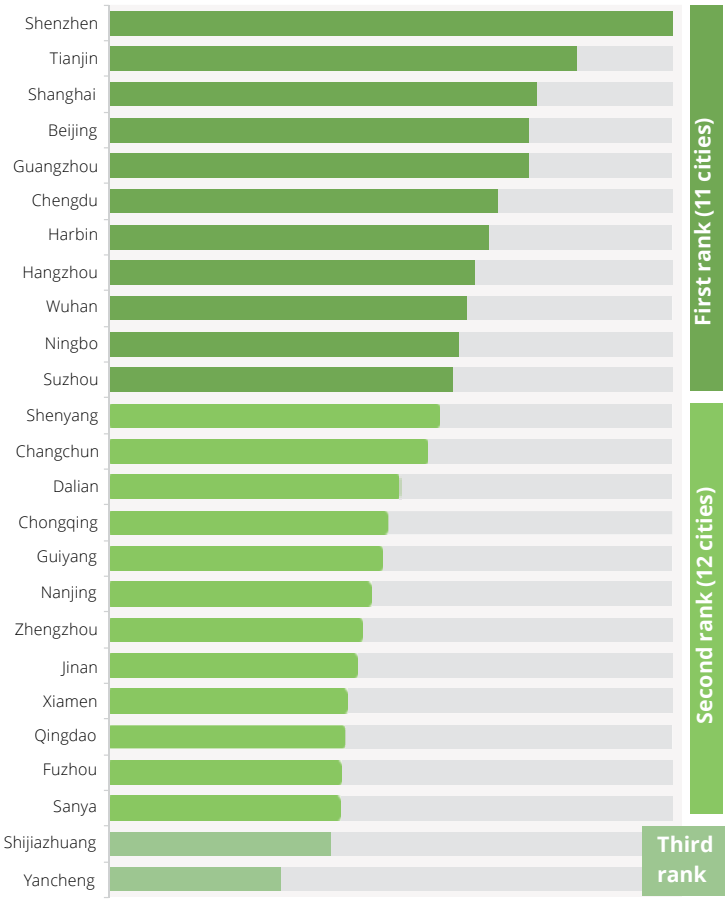
2

In the fundamental technology area: first-tier cities actively attract businesses to participate in smart infrastructure construction. There are many data centers and IoT businesses in the country, which will not only promote the rapid development of high-tech industries, but will constantly expand the scale of technology industries, realizing improvement in data and application, and expanding to the inland regions.

Figure: Rankings by strategic dimension

First-tier and second-tier cities are leading in technology development	
IoT	• The development scale of IoT in first-tier cities with smart and information-based industrial manufacturing is better. The IoT deployed in 12 cities has influenced industries worth of billions. • Many IoT industrial bases have been set up in China. Places like Shenzhen, Guangzhou, Tianjin and Nanjing have set up "smart city IoT industrial parks" to attract businesses engaging in information technologies and Internet Plus. For example, Shanghai has set up China's first "IoT industrial alliance" in Zhanjiang Hi-Tech Park.
Cloud computing	• Platform operation and management mechanisms with local characteristics have been developed. Xiamen, Wuhan, and Dalian have taken the lead in developing data industry by issuing specific IoT development planning; Chengdu and Chongqing, located in the central and western regions, are the development bases of M2M. However, research on key sensors and embedding technologies in small and medium cities are slightly inadequate.
Big data	• In general, China's big data industry is in a fast growth period. Active big data job markets are located in Beijing-Tianjin-Hebei area, Yangtze River Delta, and Pearl River Delta. Despite having a relatively active big data job markets, Nanjing, Guiyang and Tianjin are facing with talent shortage. • Guiyang Big Data Exchange, China's first big data exchange, has currently attracted more than 400 business members including Huawei and achieved over RMB70 million in transaction value; Yancheng has built a national big data industrial park and is expected to achieve RMB100 billion of output value by 2020.
Mobile Internet + Broadband network	• China will enter the 5G age by 2020. Beijing and Shanghai have launched various performance tests or deployments. • The gap between eastern cities and small and medium cities are widening, since the penetration of mobile Internet in developed cities has exceeded 100%, while that in some small and medium cities is still less than 50%.

Figure: Rankings by sector – technical dimension



Source: Report of the Big Data Development in China, China City Statistical Yearbook 2016, Deloitte Research

3

Sector penetration clearly reflects that some second-tier cities have surpassed first-tier cities and perform well in the development of safety, health, and smart environment protection.

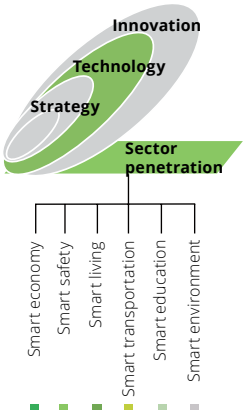
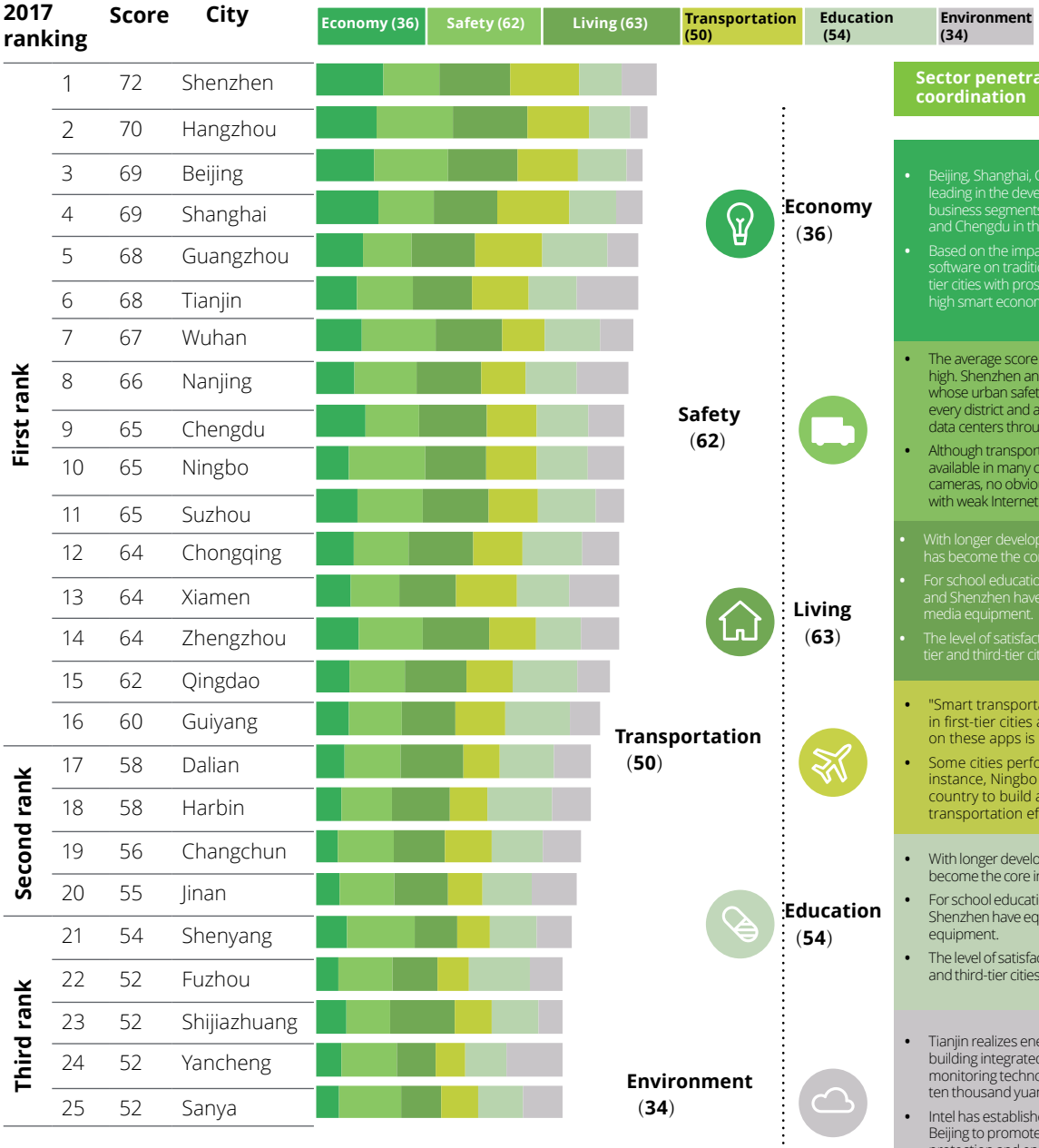


Figure: Rankings by sector – sector penetration



Source: Report of the Big Data Development in China, China City Statistical Yearbook 2016, Deloitte Research

Sector penetration requires balance and coordination

- Beijing, Shanghai, Guangzhou, and Shenzhen are leading in the development of the logistics, retail, and business segments, followed by Wuhan, Hangzhou, and Chengdu in the top six of business segments.
- Based on the impact of IoT and mobile payment software on traditional industries, developed second-tier cities with prosperous services industries achieved high smart economy indexes.

- The average score of the smart safety index is relatively high. Shenzhen and Shanghai are "China's safest cities", whose urban safety monitoring systems are deployed in every district and are connected with local government's data centers through IoT.
- Although transportation services query has been made available in many cities, due to incomplete coverage of cameras, no obvious effect has been seen so far in cities with weak Internet market infrastructure.

- With longer development history, the education sector has become the core industry in Northern China.
- For school education, Beijing, Shanghai, Guangzhou, and Shenzhen have equipped all schools with multi-media equipment.
- The level of satisfaction of family education in second-tier and third-tier cities is slightly low.

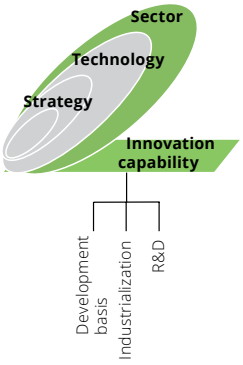
- "Smart transportation" apps have been widely used in first-tier cities and the level of satisfaction of users on these apps is high.
- Some cities perform very well in some aspects. For instance, Ningbo has become the first city in the country to build a green wave system to improve the transportation efficiency at crossroads.

- With longer development history, the education sector has become the core industry in Northern China.
- For school education, Beijing, Shanghai, Guangzhou, and Shenzhen have equipped all schools with multi-media equipment.
- The level of satisfaction of family education in second-tier and third-tier cities is slightly low.

- Tianjin realizes energy conservation management by building integrated and systemic smart environment monitoring technologies. The energy consumption per ten thousand yuan GDP decreased by 7.21% in 2016.
- Intel has established a united smart energy lab in Beijing to promote smart development of environment protection and energy conservation industries.
- The level of focus paid to smart environment by tier-three cities is not adequate.

4

Smart cities take innovation as the driving force: the innovation capability of 25 cities varies dramatically. The radiation effect has been formed in Yangtze River Delta and Pearl River Delta; weak development basis has made R&D the weakness of most cities in Central China, impeding innovation industrialization.



Developed cities have solid development basis

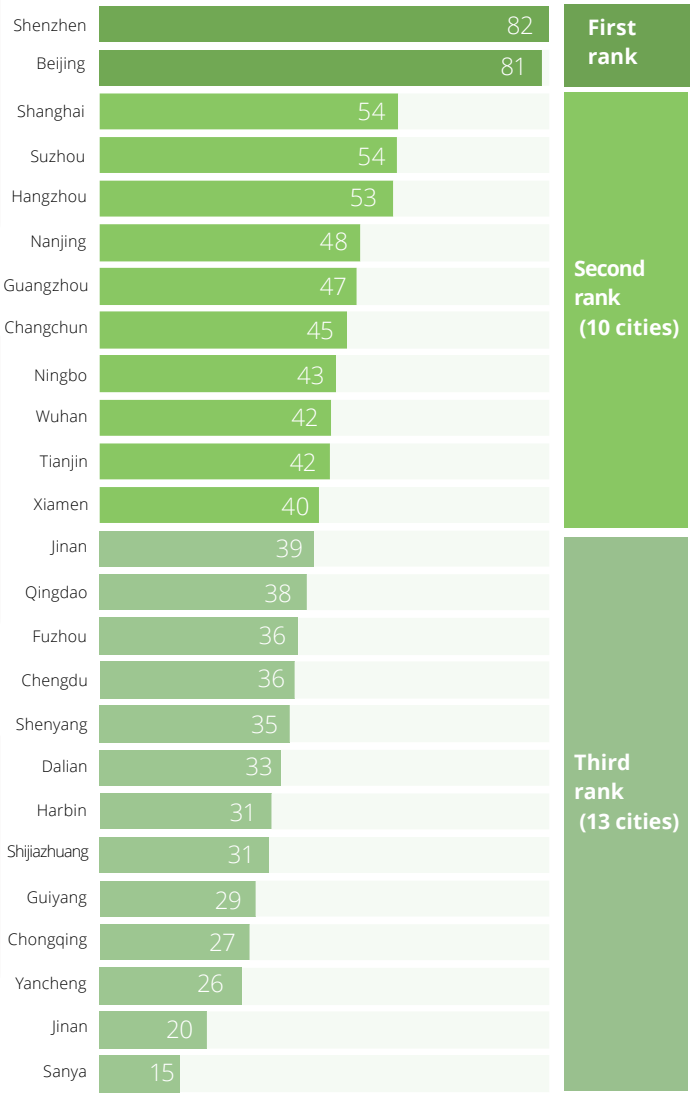
- Among Beijing, Shanghai, Guangzhou, and Shenzhen, although Shenzhen has the smallest economic size, its per capita GDP and level of openness are high. Moreover, it performs very well in the scale of innovation R&D and innovation industrialization, and has established a leading innovative industries center, which has the best innovation development basis.
- Most cities in Northern China rank top in talent index for having a large number of higher education institutions and research institutes, but most of them lag behind in innovation index for limited consumption ability, market size and large proportion of traditional industries.

- Beijing Zhongguancun Science Park, Shanghai Songjiang High-tech Park, and Shenzhen Luohu Smart City Industrial Park have formed the clustering effect by attracting technological innovation-based companies and gathering large amount of IT talent.
- In the Yangtze River Delta, for example, Hangzhou and Suzhou have strong industrialization capabilities for the concentration of innovative businesses, active financial institutions; as Wuhan and Guangzhou are fettered by traditional R&D systems, the problem of R&D-production imbalance still exists.
- Cities in Central China are inferior to cities in Eastern China in industrialization for their weak economic basis.

Innovation R&D requires resource support

- While Beijing excels in basic scientific research and Shenzhen is good at business innovation, Shanghai lags behind for not having BAT and new types of research institutions that directly serve the market despite solid development basis; Guangzhou leaves little R&D space by investing too many resources into capital intensive industries due to the traditional industrial structure which centers on heavy chemical industries.
- The second-rank cities are weaker in innovative development compared to leading cities mainly for two reasons: first, the shortage of R&D resources and technical talent is hard to inspire innovations; second, the development of innovation industries lacks motivation.

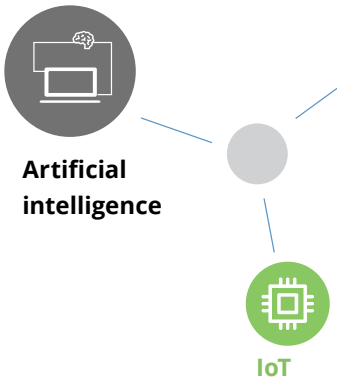
Figure: Rankings by sector – innovation dimension



Source: Guangdong Academy of Social Sciences, China City Statistical Yearbook, Deloitte Research

Focus on Shenzhen: build an all-round smart city by leveraging local technology companies

- In April 2016, Tencent set up the AI Lab in Shenzhen to conduct open research on basic AI science and in-depth application research.
- Huawei has built a technical team with over 100 people in Shenzhen to focus on voice technology development.
- Unicorn businesses in Shenzhen are also beginning to rise in AI area. Among the world's top 50 start-ups that leading the AI innovation revolution, three came from China (including two Shenzhen-based companies, namely iCarbonX and Ubtech).



- Currently, Shenzhen has more than 30 listed companies engaging in cloud computing and big data. Businesses like Tencent, ZTE, Mindray, and Thunder constantly invest in big data area, the capital size of which is expected to exceed RMB100 billion.
- As a National IoT Demonstration Zone, Shenzhen has obvious advantages in developing IoT industry. The establishment of Smart City Industrial Park in Luohu High-tech District has attracted many IT and "Internet Plus" businesses.

Smart transportation

Shenzhen Traffic Police Bureau joins hands with Huawei to explore the best transportation design and management model. Both parties will co-develop the smart video sensing joint project, intelligence big data joint project, and transportation management big data joint project to manage traffic flows, reduce safety accidents, and eliminate hidden traffic hazards based on smart application.

Smart government

Shenzhen has basically built a unified government information and resources sharing platform, which integrates 385 categories of information and resources of 29 units, including over 3.8 billion items of data; currently, 49 directly affiliated municipal institutions and all district governments have shared information via this platform. The peak data exchange volume per day is as high as 80 million items.

Smart services industry

Koubei, an o2o local life services platform under Alibaba, will collaborate with businesses in Shenzhen to develop smart shopping experience, which will integrate online and offline channels with QR codes and provide industry solutions for merchants and CBDs based on big data, ISV, etc.

Smart healthcare

The Public Hospital Administration Center of Shenzhen Municipality has developed a healthcare services platform, Jiankangyi, which can provide citizens with various healthcare services via mobile apps.

Many hospitals in Shenzhen have rolled out a new function of WeChat payment for medical insurance. As estimated, this new function will, on average, save 46.3 minutes of waiting time.

Smart livelihood

Shenzhen Municipal Public Security Bureau has officially launched some new services (e.g. online police services column and three kinds of household registration migration services) onto its online service platform. Citizens can save much time of queuing and directly log on to the online service platform to manage changes online, and manage household matters by facial recognition.

Source: public information from the Shenzhen municipal government, Deloitte Research

Focus on Hangzhou: build a smart city that aims to provide public-interest services

Smart transportation

Full coverage of all transportation areas

- **Public transportation enters the Internet age:** public bike, bus, subway, and online car-hailing services can be paid by using mobile phones. The amount of subway ticket purchase via Alipay has exceeded RMB9 million.
- **Roll out smart traffic signal system:** the "City Brain" platform performs real-time analysis and automatically adjusts public resources. For example, Hangzhou has increased the traffic efficiency by 11% by adopting smart traffic lights on some urban road sections.
- **Other areas:** mobile parking payment and online processing of traffic violations, fines, reports, etc.

Smart healthcare

Process improvement

- **Mobile healthcare services:** the app named "Hangzhou Smart Healthcare" (**杭州智慧医疗医护版**) helps doctors and nurses to understand the drugs patients are taking and doctors' advices, improves patient management, and helps to achieve better doctor-patient interaction.
- **Simplifying healthcare processes:** "Hangzhou Smart Healthcare" simplifies the processes of making registration, waiting for medical consultation, collecting medical reports, and collecting medicines, and greatly reduces patient backlog.

Smart safety

- **Building a public safety prevention and control network:** Hangzhou deepens the reform of police affairs and builds a well-organized and high-tech public safety prevention and control network based on cloud computing, big data and the Mobile Police System.
- **Emergency response:** since its establishment, the 110 Social Emergency Response Platform has directly arrested 12 suspects and helped to arrest 50 persons. Moreover, 32 units have been connected district-wide via the 110 Social Emergency Response Platform.

Smart government

- **System integration:** integrate digital urban management, planning system, financial system, and business system on the e-government extranet to provide one-stop services
- **Data sharing**：build integrated smart e-government management system and gradually develop an integrated, shared, open, and secure mechanism of government data based on the smart e-government cloud platform, including more than 300 items of data in credit, transportation, education, environment, etc., which can be accessed by keyword search.
- **Government efficiency improvement**：taxpayers can pay taxes and sign business contracts online.

Smart living

Online services cover all aspects of life

- **Utilities payment:** over 15 million people have used the online water, electricity, and gas bills payment service
- **Weather:** real-time typhoon query
- **Library:** online registration, online search of books and events, online payment, etc.
- **Tourism:** online search of tourist attractions, accommodation, transportation, entertainment, etc.

Source: public information from the Hangzhou municipal government, Deloitte Research

Focus on Guiyang: build a big data industry chain and lead smart city construction

Guiyang, a pilot zone for big data innovation, aims to build a complete big data industrial chain ranging from technical research to data collection, mining, analysis, processing, application, and develop into a block data city by means of big data transactions.

Infrastructure

- **Build the regional communication hub in Western China:** strive to be listed as a National Internet backbone straight point, apply for the project "Next Generation of Internet Demonstration City", and develop into a "Wireless Broadband City"

Cloud cluster

- **Implement "Cloud Service Project":** develop big data cloud services industry clusters

Terminal cluster

- **Launch "Intelligent Terminal Project":** create intelligent terminal industry clusters

Data application

Commercial services:

- "Big data + finance": invest and establish Guizhou Zhongqian Financial Assets Transaction Center, which recorded RMB5.544 billion of transactions in 2016
- "Big data + big health": develop sub-platforms such as integrated tumor big data center, tumor patients community APP, online tumor hospital, remote diagnosis, connected electronic medical records, tumor doctor community APP and online pharmaceutical businesses based on the "One Platform, One Group" model

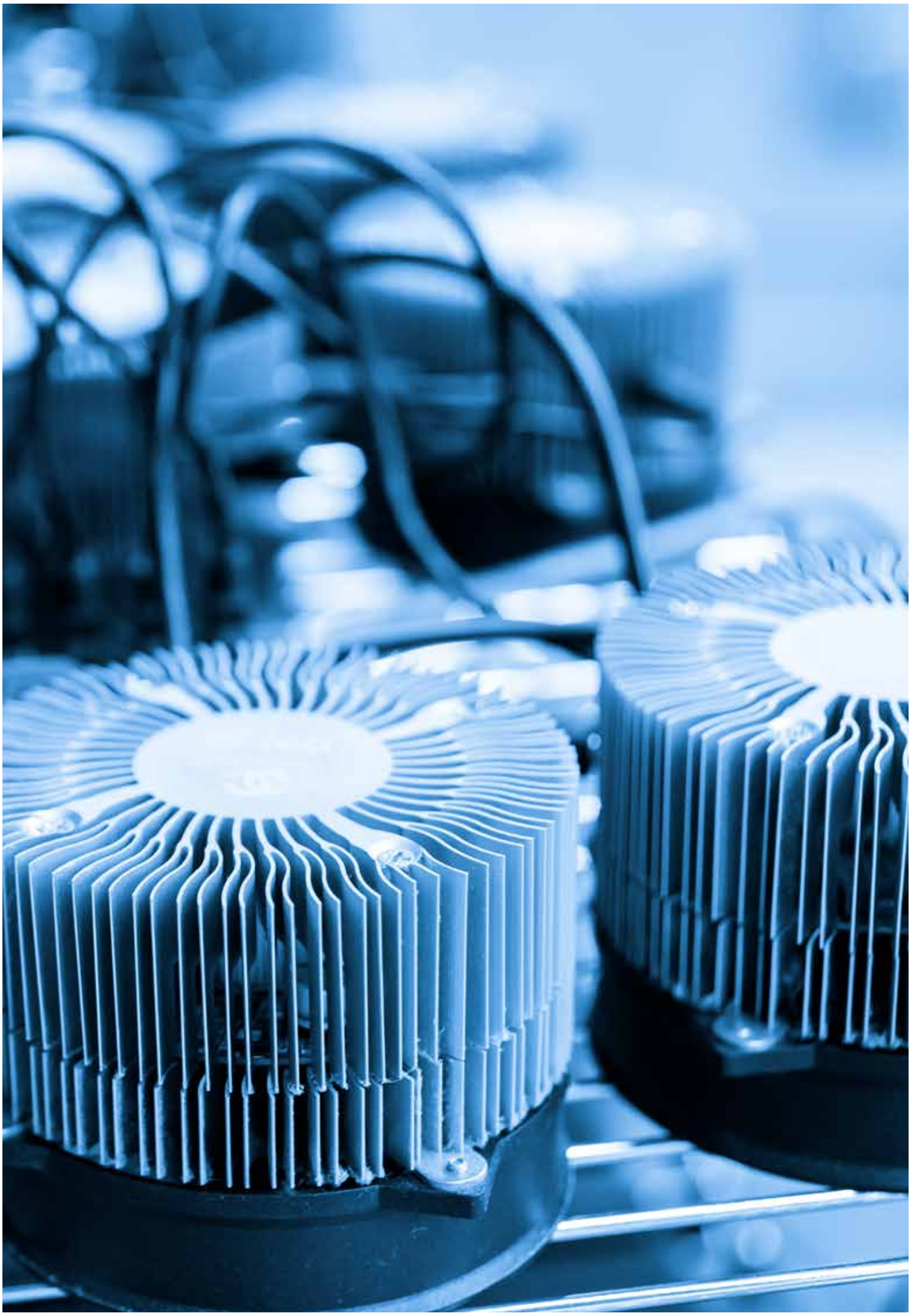
Civilian services:

- Big data education: introduce smart education platforms, build big data resource database for teachers and teaching materials, and complete teacher competence evaluation, assessment and certification, and guidance based on big data analysis;
- Big data healthcare: establish the big data center on diabetes prevention and control to collect, analyze and monitor the information of diabetic patients in real time, which has been adopted in 40% of counties (cities and districts) in Guizhou in 2017

Government services:

- Build the "Society and Cloud" Platform, Healthcare Information Platform, Big Data-based Comprehensive Tax Administration System, the System for Monitoring, Warning, Commanding, and Managing Geological Disasters and Potential Risks in Projects under Construction, and Big Data Social Governance Platform to constantly deepen the application of big data in government services

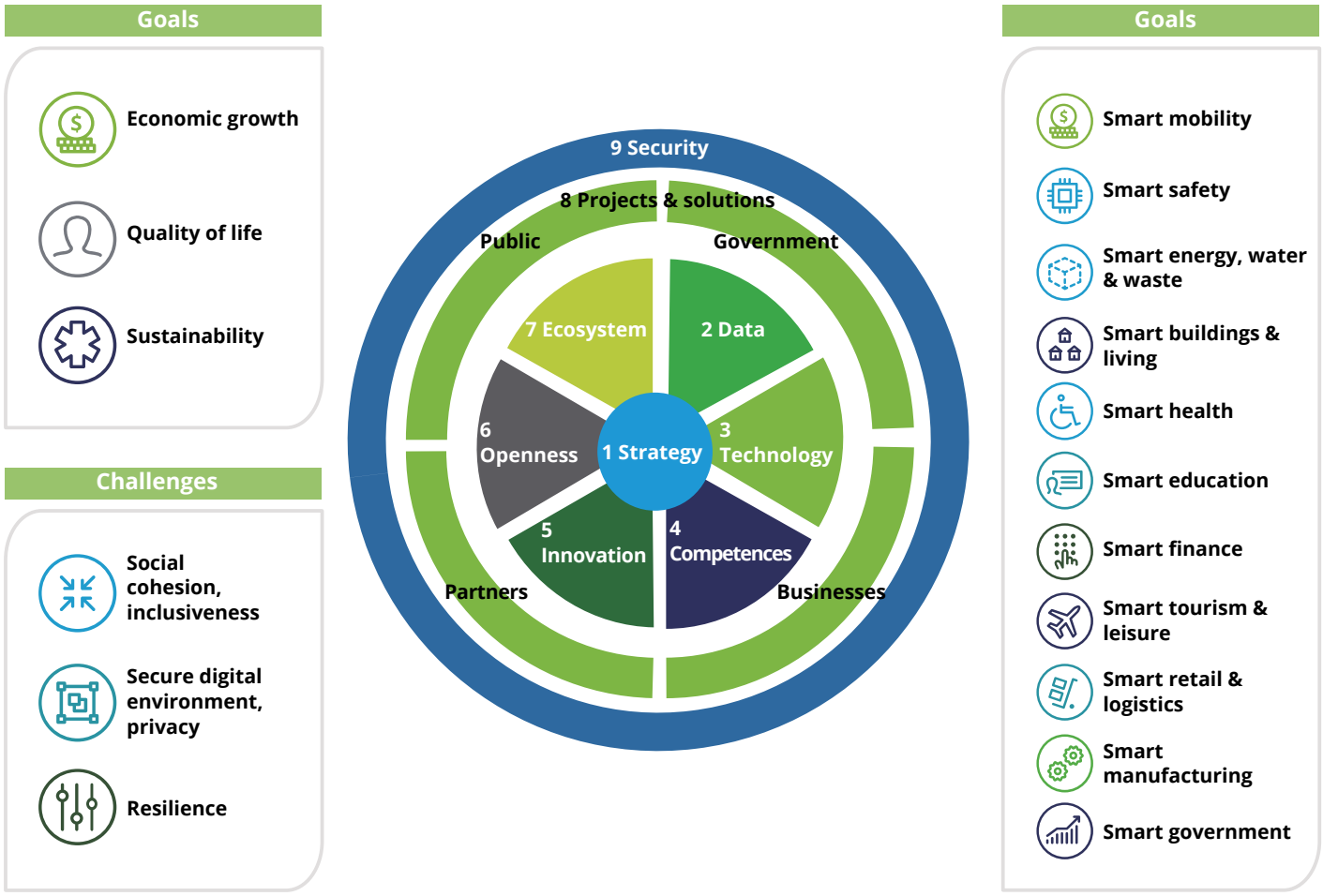
Source: public information from the Guiyang municipal government, Deloitte Research



Building a super smart city

Faced with multiple challenges, today's urban managers will need to consider a nine-dimension capability framework in the urban construction process if they want to break through the conventional smart city boundaries and transform the city into the "super smart city". Meanwhile, they also need to take account of the actual needs of the city with an aim to create a happier society with higher quality.

Figure: Super smart city capability framework



Super smart cities have a clear vision of what they want to be and a strategy to realize this ambition. A clear vision is required as effective counterweight to technology push.

Strategy

- Super smart cities need differentiated strategies
- Solve challenges and seize opportunities by harnessing strategies and technologies
- Focus their resources on what brings value to the city not only on the short term but also in the long term
- A clear vision is the only effective counterweight to the technology push of vendors
- Change the unpredictability of disruptive technologies
- Smart cities needs planners to think outside the box

Data

- The combination of various sources of fine grain data allows a city to develop real insight into societal challenges like sustainability, mobility, health and security
- The ability to extract data from a wide array of sensors provides real-time insight in transportation flows, energy flows and pollution
- A real smart city is capable of combining information from multiple sources that have traditionally not been used in combination

Technology

- Digitalization and state-of-the-art and open networks are the foundational infrastructure of super smart cities. Networks for digital connectivity are required in three different forms:
- Fixed broadband networks, facilitating gigabit connections
- Mobile broadband networks, 4G and 5G networks providing ubiquitous internet access to people using mobile devices
- Internet of Things (IoT) networks, characterized by long range and very low energy usage
- Super smart cities require massive use of sensors
- Sensors of different standards can work together
- Super smart cities need mature IoT platform software to manage the sensors

Competences

- The use of disruptive technologies for innovation requires new skills and competences in the city, in particular related to data
- Super smart cities need a lot of "data scientists"
- Super smart cities need experts who understand the mechanisms of human behavior and change human behavior

Ingredients needed to build a super smart city

Openness

- To obtain more new creative ideas, a smart city requires openness, the willingness to experiment and to take calculated risks
- It requires new types of collaboration between different departments in the government and with stakeholders
- In the development phase smart cities are in, failures are necessary to develop insight and to learn

Innovation

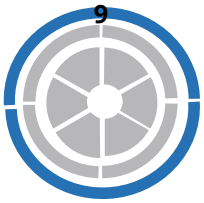
- Powerful ecosystems can only emerge if the right partners are present in the city. Creativity, deep technological expertise and the ability to execute are vital components.
- This is called the "war on talent" among the megacities of this world. Cities should focus on the type of talent that fits the long term development of the city.
- The transition of the labor market requires new jobs and new business opportunities. Cities must have a strategy to attract those investments and businesses and create a climate in which startups can flourish.

Ecosystems

- Smart cities require ecosystems of public and private parties to co-create smart solutions
- In such an ecosystem, neither of the participants has top-down control. Instead, the ecosystem has the power to deliver create new solutions that neither of the parties could have realized on its own.
- In these ecosystems, the role of government is to identify the areas that have potential but lack sufficient new initiatives and to play an active role to gather parties that normally do not work together in a new creative ecosystem.

Projects & solutions

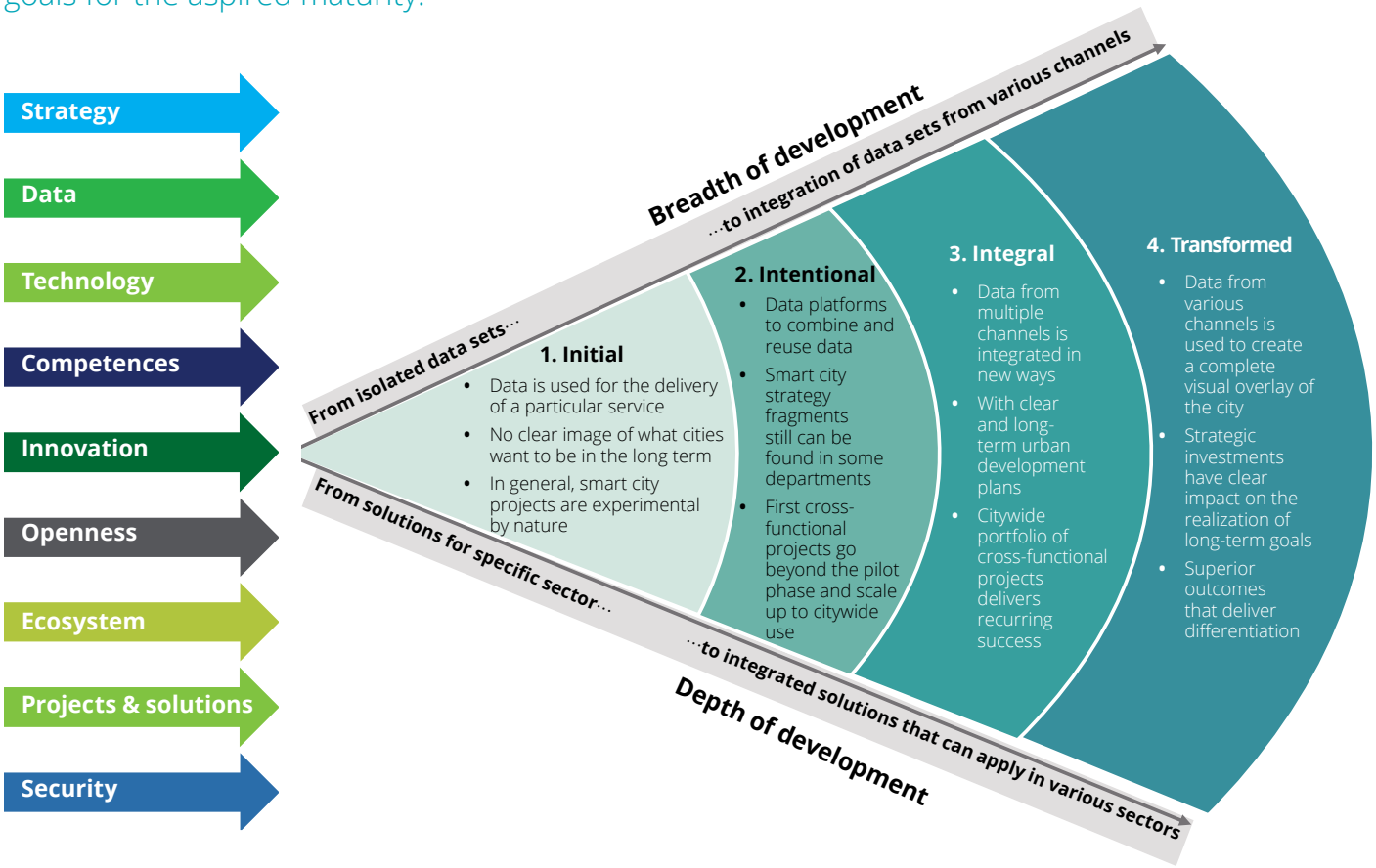
- Smart cities should invest both in new disruptive technologies and in human capital
- Technological innovations must be combined with social innovations to create sustainable solutions
- Smart city initiatives typically start as sectoral, small scale and experimental. This phase is necessary to learn and to improve the solutions. Each small scale initiative must be based on a scalable business model that allows piecemeal success to be broadened to city scale quickly and efficiently and without having to change the solution.



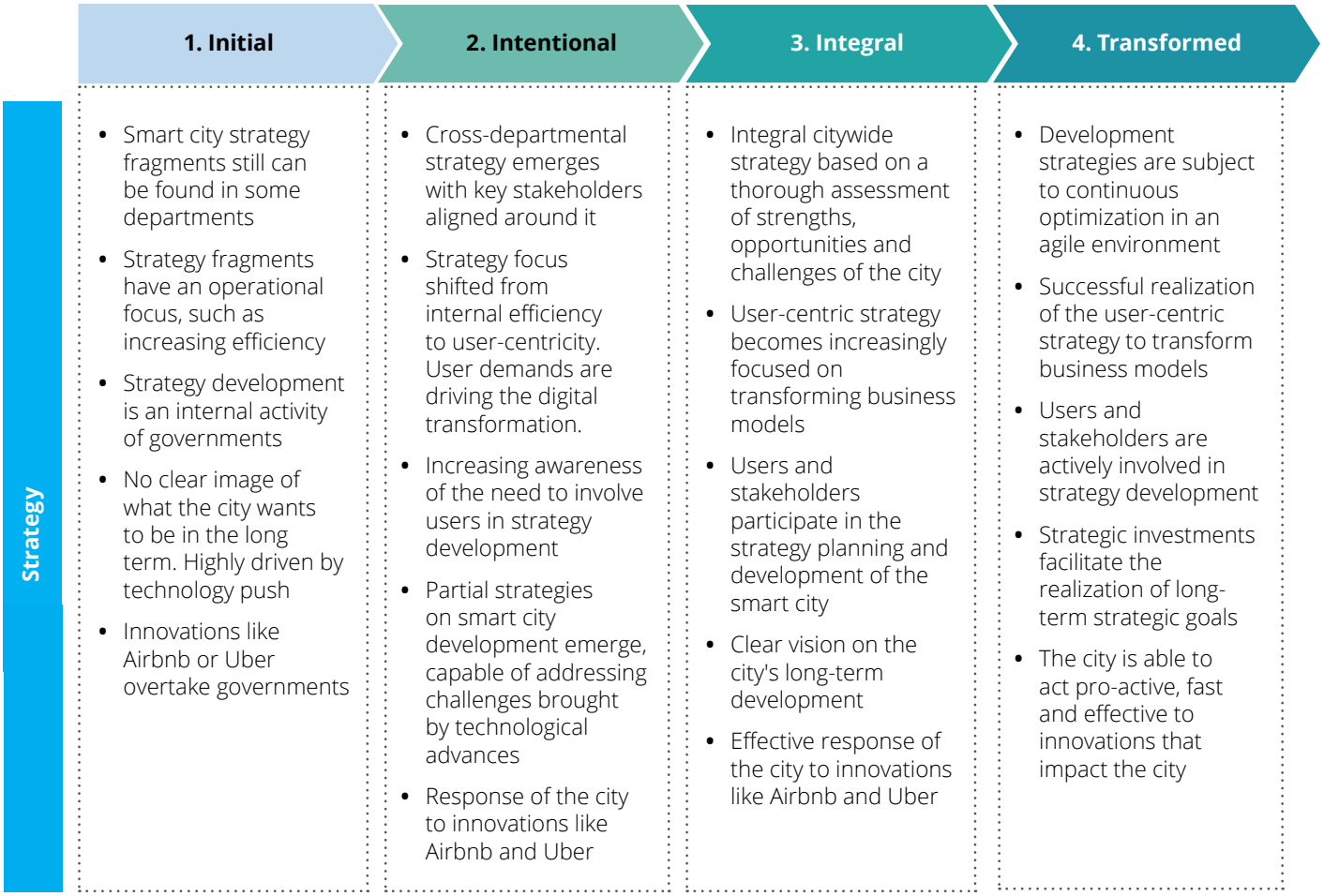
Security

- Infrastructure security and controllability are vital to the sustainable development of a smart city.
- In the development of a smart city, cybersecurity, information and data security, and application system security must be guaranteed.
- A cybersecurity technology system that can realize active monitoring and real-time protection and a contingency platform that integrates commanding, management and processing are the development goals and directions of the information security of a smart city.

Four stages of building a super smart city: smart cities do not emerge overnight but develop over the years. During this development process, cities grow from early maturity phases to fully developed maturity stages. The maturity model is used to assess the current maturity and set goals for the aspired maturity.



Four stages of building a super smart city



Four stages of building a super smart city

	1. Initial	2. Intentional	3. Integral	4. Transformed
Data	• Data is collected in the context of traditional city processes only • Data is used for the delivery of a particular service and not re-used for other purposes • Analysis of data on isolated data sets only • Data is stored in disparate systems and is difficult to access and combine • Public data is only historic data, but not real-time data • Data quality of open data is not guaranteed due to the absence of mature data management processes • Policies for data sharing, privacy, anonymization, authorization, management, etc. are not in place	• Small scale pilots to collect data specific for smart solutions are in place • Small scale re-use of data to fuel smart solutions and data analytics • Pilots with more advanced data analytics on city data emerge • Data platforms to combine and re-use data • Pilots that can provide real-time (IoT) data are being set up. • Preliminary data management standards and processes are developed • Partners (cities and external parties) have identified the need for data policies	• Citywide collection of data specific for smart solutions is operational • Data from multiple channels is combined in new ways • Data analytics is applied on combined data sets to provide new insights • Government services and external partners use the data platform for their open data • First examples of real-time data are operational • Data management standards and processes are being improved • Partners have agreed a first version of data policies and start using them in practice	• Data fueling the full spectrum of smart solutions is collected • Citywide use of mature advanced data analytics (real-time, big data, predictive) • All data is available through a single database and via open standards • Operational data management standards and processes, data quality is guaranteed • Data use by parties in the ecosystem is governed by agreed data policies

Four stages of building a super smart city

	1. Initial	2. Intentional	3. Integral	4. Transformed
Technology	• Fixed and mobile broadband networks are in place • Technology architecture provides point solutions for line of business applications • Limited investments in sensors and M2M networks	• Shared architectures are deployed on a limited set of services • Stakeholders are intentionally investing in sensoring technologies • Dedicated M2M/IoT networks are in place	• Implementation of a unified platform to manage all kinds of sensors • Joint investments plans for deployment of connected assets with multi-purpose sensors • Unified standards and policies are in place	• Establishment of a cross-departmental unified platform • Continuous improvement of the joint architecture to support innovation and transformation • Citywide deployment of connectivity infrastructure and sensors networks for smart solutions
Competences	• No clear view on the skills and competences that are needed to execute the digital strategy successfully • Smart city initiatives are executed with existing competences and technologies	• Required skills and competences are pinpointed and a plan for developing the workforce capabilities is in place • Efforts mainly directed at equipping existing workforce with innovation awareness	• Skills and competences of the workforce are improved but deficiencies still exist at some pockets of expertise • Efforts are made to develop new skills for the workforce: research and analysis, technology skills, agile project management, user experience skills, modelling for digital business models and commercial skills	• Governments use a blend of investment, innovative approaches and external support to secure the right skills and competences • The next generation of talent is attracted by a workforce strategy that highlights the impact of work on the lives of citizens, and by offering employees the flexibility to work creatively

Four stages of building a super smart city

	1. Initial	2. Intentional	3. Integral	4. Transformed
Openness	• Low appetite for taking risks. Mechanisms for employee appraisal favor a risk-averse way of working • Governments tend to focus on securing internal buy-in rather than on delivering customer needs	• Growing awareness of becoming open to new ideas, experimenting and taking calculated risks • Governments are actively looking for new ideas through competitions, hackathons, etc.	• Citywide transition towards an altered attitude to risk and willingness to experiment with new ideas • New ways of collaboration between departments and with external parties emerge	• The "fail fast, fail quickly and fail cheap" approach has become part of the organization's DNA • Ability to learn fast and to adopt new ideas quickly
Ecosystem	• Siloed internal organizations with respect to smart cities • Businesses purely in the role of technology vendors • Attempt to match technology push with existing city policies	• Internal and external collaboration is growing • Governments are still organized in traditional ways, but becomes conscious of its assets (i.e. date) and open for new ways of working together with external parties	• Governments are becoming part of creative public-private ecosystems in which neither of the participants has top-down control • Parties in these ecosystems are working together to create a result that has value for them all	• The new way of working in creative ecosystems has transformed the government organization itself • Governments successfully play new roles in the creative ecosystems

Four stages of building a super smart city

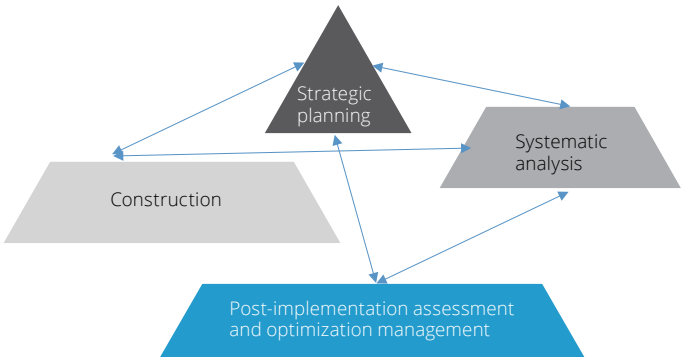
	1. Initial	2. Intentional	3. Integral	4. Transformed
Projects & solutions	• Department-based projects are driven by technologies and random initiatives • In general, projects are experimental by nature • Mainly small scale pilot projects and proof of concepts to prove the business case for further investment • Project execution and monitoring is subject to classic project-bureaucracy	• Cross-departmental projects emerge, but still in small number • First cross-departmental projects go beyond the pilot phase and scale up to citywide use • First attempts to execute innovation projects in an agile way	• Citywide portfolio of cross-departmental projects delivers recurring success • Citywide foundational technology, processes and standards emerge • Benefits tracking is in place	• Initiatives are focused on innovation • Continuous improvement of service delivery brings competitive advantage • Superior outcomes that deliver differentiation
Security	• Protection system, evaluation system, and organizational planning are germinating • Absence of national standards on information security, data openness, etc. • Key infrastructure facilities and information technology are inferior to foreign counterparts	• Look to adopt proprietary and controllable information-based core technologies and information infrastructure • Completion of information security system design in the top-level design and formulation of national standards on data openness	• Establishment of a unified center for centralized information safety operation & maintenance • Complete cybersecurity technology monitoring and protection on cloud space, networks, and terminals • Establishment of contingency platforms based on the center of cybersecurity data exchange and analysis	• Formation of the cybersecurity data analysis system to achieve active monitoring and real-time protection • Provide customized security solutions for different sectors and policy users

Seven key lessons

1 Super smart cities require effective overall strategic planning from top to bottom.

Smart city planning and analysis construction in the past are complicated

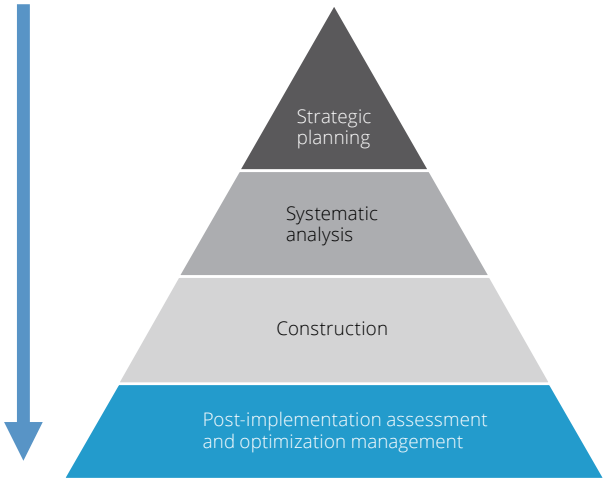
"Not clearly structured"



- Different urban departments have inconsistent construction planning due to their different understanding of smart cities, leading to issues including varying construction levels and progress of smart cities and departmental silos.
- Isolation among different areas and separation of technologies and functions in the top-level design, so it is hard to achieve sustainable and forward-looking urban development.
- There is no overall strategic design to coordinate the technical frameworks, application of new technologies and business models.

The construction of super smart cities is well structured from top to bottom

"Clearly structured"



- Top-level strategic planning can avoid confusion and disorder in practice.
- The clearly organized structure from top to bottom includes construction resources, targets, supporting technologies, assurance policies and systems, and necessary operational and management organizational structures.

Strategic goals, leadership, success factors and potential risks are the four dimensions to be considered in the design of the overall strategy.

Strategic goals

- At design level:
- Based on a comprehensive strategic plan, develop a sustainable construction plan for the super smart city with a systematic approach on an overall
- Focus on key sectors and identify priorities while centering on the core objectives of users
- Intensify the use of smart systems in key sectors to build an efficient, fast and inclusive public service framework
- Design paths to achieve strategic goals for elements at all levels
- Set up a refined management system to be integrated with economic and social development
- At implementation level:
- Conduct analysis and framework construction from the perspective of business, data, system and technology
- Align, share and coordinate goals, functions, frameworks, data and resources
- Reasonable supporting measures including process re-engineering, knowledge spreading and data refinement
- Identify the cooperative relationships between businesses and systemsand those among different tasks

Leadership

- The commitment of local government leaders to creating, communicating and promoting sustainable development plans
- The integration of local resources, coordination and communication, and collaboration requires adequate coordination and communication among the municipal level, the district level and all departments
- Governments to incorporate the standards of super smart cities into the service procurement process
- Governments to make data and city planning open and engage the public in the overall planning and collect their opinions to achieve social consensus
- Governments to facilitate the integration of social public services, including the services provided by governments and by businesses and through public-private cooperation to deliver a prosperous super smart city

Potential risks

- Planning risk: to consider smart cities as the combination of industrialization and information technology with insufficient understanding and incorporation of urbanization and green development
- Organizational risk: urban departments build their own projects as planned, leading to issues such as duplicate construction and waste of resources
- Technological risk: extensive technology replication without core key technologies
- Talent risk: no relevant professionals to implement the initiatives
- Profit risk: difficulties in overall operation due to immature profit models of public services, making it hard to establish investment and financing mechanisms
- Financing risk: no sustainable funding

Success factors

- Thoroughly consider the cross-functional coordination through top-level design before commencing construction
- Cities are increasingly concerned about the resident experience, the application of new technologies and business models
- Adopt the comprehensive complex macrosystem which is diversified, interactive and dynamic
- Avoid being IT system driven, as the numerous IT systems are operated by different providers which have different system linking protocols
- Avoid limited opening of data and information silos, which will forbid the optimized use of data

2 Super smart cities are not large-scale replicas.

Currently, solutions are repeatedly used in the construction of super smart cities

"Cities are replicated"

- Some places directly use the smart city solutions available internationally or commercially without considering their own advantages and disadvantages.
- This is because the construction and operation of super smart cities is a new discipline for domestic participants who have limited understanding on this discipline.
- The construction of super smart cities is primarily driven by the government, and the engagement of businesses and the public is yet to deepen. As a result, it is hard to develop targeted strategic planning based on the needs of local businesses and the public.

In the future, regional characteristics will be fully considered in construction and operation

"Cities are customized"

- As governments have a better understanding of the construction of super smart cities, the approach to construction based on the city's own advantages and local conditions will become the mainstream.
- For example, the key focus of Shanghai's smart city planning is the integration of the Internet with the economy and society, which incorporate the Internet into life scenarios to extend the application of the Internet, providing more conveniences to residents' daily life. While Ningbo lags behind Shanghai in terms of economic development, their livability index is higher. Therefore, Ningbo focuses on "livability" in the construction of their city by leveraging their tourism and cultural industries.

Multiple factors including the city's own characteristics and resources as well as the city's actual foundation and conditions must be considered to develop a construction plan for distinctive cities.

Lack of inter-city cooperation

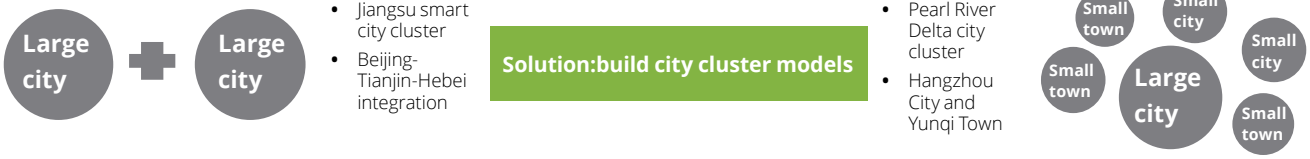
- Independent city planning could lead to inconsistent planning in the same region with unreasonable industrial distribution and a lack of economic cooperation and complementation among regions.
- Smart cities should focus on cooperation and complementation to achieve more reasonable coordinated planning in the region.

Lack of regional characteristics

- Smart cities may learn from the construction experience of classic urban agglomerations and define the positioning of components to create regional development characteristics.
- Cities should focus on their own characteristics and promote the integrated construction of regional economy when they develop smart cities.

Lack of industrial collaboration

- Proper industrial division of work and collaboration should be formed among smart cities to drive them forward.
- Cities should focus on their own characteristics and promote the integrated construction of regional economy when they develop smart cities.

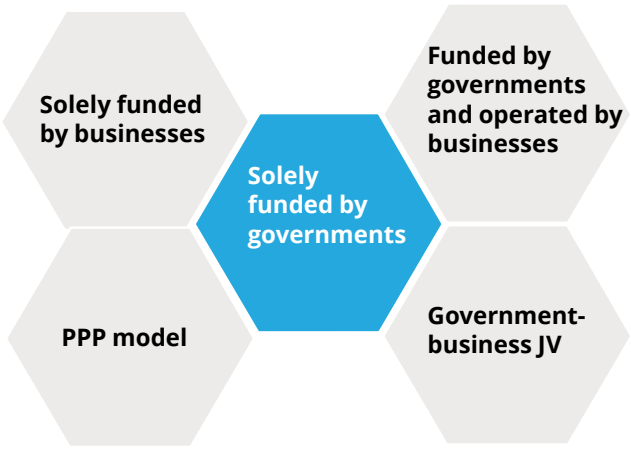


Cross-city cooperation	• Among the eight cities in the Jiangsu Yangtze River city cluster, Nanjing is set as the core with Jiangbei New Area as the bridge to connect southern and central Jiangsu, achieving an orderly and efficient cross-city cooperation. • These provinces and cities will have a prosperous future in the joint construction of information infrastructure of smart cities, sharing of connected public services and industrial collaboration. Yangtze River city cluster covers eight cities in Jiangsu, with the overall economy reaching RMB6 trillion.	• The Pearl River Delta city cluster is an exemplar of the city cluster model, where small cities are driven by large cities: Guangzhou serves as the core city to drive the smart development of cities in the Pearl River Delta. • Hangzhou and Tongxiang are exemplars of the city cluster model, where towns are driven by cities: Yunqi Town in Hangzhou leverages advanced Internet companies in Hangzhou to develop itself into an ecological town featured by smart economy.
Maintain regional characteristics	• With respect to the environmental issues emerged in the development of the city cluster, the Beijing-Tianjin-Hebei integrated smart city cluster builds smart cities addressing resource issues and environmental symbiosis to become smart and green and achieve collaboration and development. • The Jiangsu city cluster focuses on smart infrastructure and platform integration and has built a comprehensive access platform for the smart city cluster of Jiangsu Province, which has connected the cities in areas including government information, public services and transportation, thus achieving smart development.	• The Pearl River Delta city cluster focuses on improving living standards with smart services and building broadband infrastructure. The city cluster integrates municipal services around healthcare, education, elderly care, social security with broadband networks. For instance, Panyu's residential mobility system. • Hangzhou builds Yunqi town with the support from Alibaba Cloud, an advanced Internet company in Hangzhou, to create an ecological agglomeration for the cloud computing industry and transform simple data into production factors by applying algorithm of big data .
Implement industrial collaboration	• In the integration of Beijing-Tianjin-Hebei area, outdated production facilities in the steel and cement industries are shut down to achieve industry takeover and upgrade. • Hebei develops emerging industries such as information technology, new energy and modern logistics in multiple cities, while Tianjin leverages Beijing to reinforce its advanced manufacturing and information industry and nurture modern service industry. • These three regions have completed the structure of industrial collaboration and provide economic and technical support for smart cities by developing high-tech industries.	• Cities in the Pearl River Delta city cluster coordinated with each other in industrial development. Guangzhou and Shenzhen act as the leaders in developing the technology industry; Dongguan develops advanced manufacturing and builds technological achievement conversion centers; and Zhuhai leverages its superior geographical location to bring in high-end talent to align with the development of the technology industry and manufacturing sector. • Hangzhou City and Yunqi Town collaborated in developing the Internet industry. Yunqi Town focuses on cloud computing industry to support the development of Hangzhou's information industry.

3 Super smart cities cannot be limited to certain models: early construction of smart cities was predominantly solely funded by governments, but multiple models will coexist in the future as participation by businesses deepens.

Being solely funded by governments was the prevalent model in early construction of smart cities

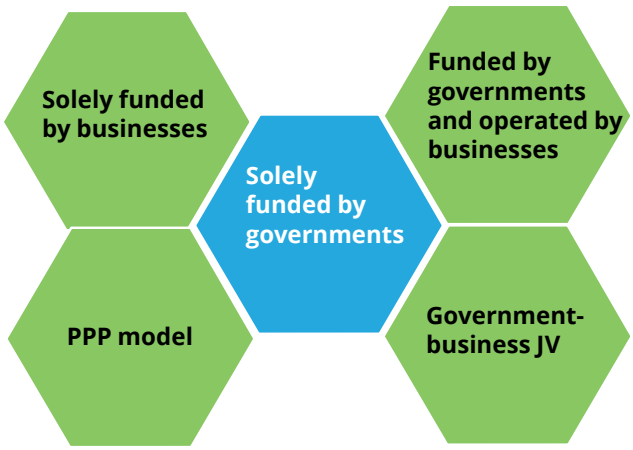
"Predominantly solely funded by governments"



- In early construction of smart cities, being solely funded by governments was the prevalent model:
- mainly because the construction of smart cities requires data resources sharing and collaboration in all sectors, especially between governments and all business units;
- for example, businesses alone cannot promote healthcare digitalization in hospitals. Even if all hospitals have achieved digital healthcare, it is also very hard to convince them to share healthcare data with businesses.

Multiple models will coexist in the future construction of smart cities

"Multiple models coexist"

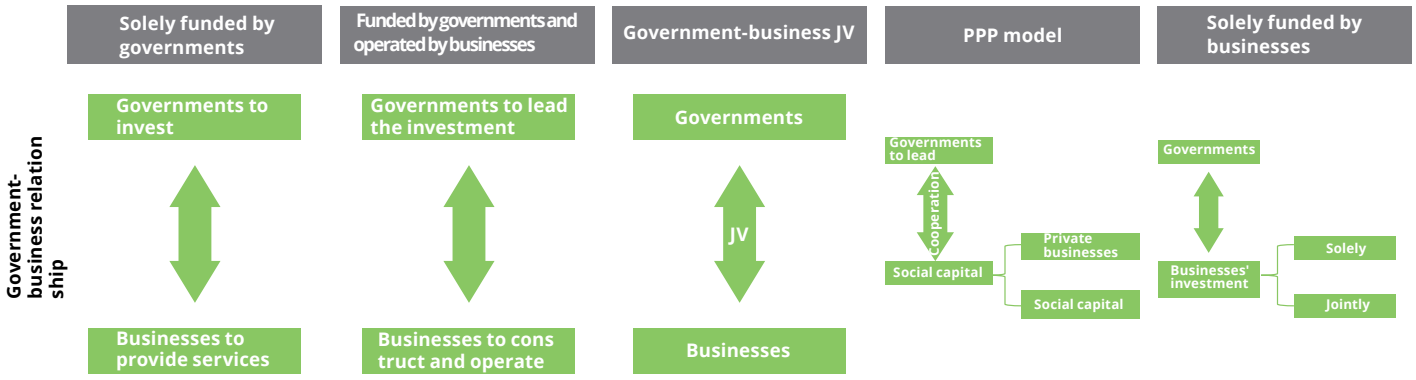


- Multiple models will coexist in the future construction of smart cities, because:
- governments will be under tremendous financial pressure, but participation by businesses will help ease their pressure;
- compared to businesses, governments have limited experience in operation and management as well as professionals in specific projects;
- the level of participation by businesses will further increase as governments at all levels will create a better environment for business participation by issuing planning policies.

New-style smart cities require model innovation. In the five major operation models, governments and businesses have different degrees of influence on funding, operation and control, with different strengths and weaknesses respectively under different models.

No.	Model	Description	Funding		Operation		Control		Strengths	Weaknesses
			Government	Business	Government	Business	Government	Business		
1	**Solely funded by govern-ments**	• Governments use their own funding and technologies in overall planning, independent investment and subsequent operation and maintenance • Provide services to municipal authorities, units and the public	●	○	●	○	●	○	• Governments can control the utilization and operation models without negotiation and consultation • Governments can fully supervise the construction and operation of smart cities • Government demands can be met first	• Governments bear all costs with substantial funding pressure • Governments bear all risks • Professionals are required as governments have no relevant operation experience
2	**Funded by governments and operated by businesses**	• Led by governments who bear the main investments with operators providing relevant support for governments, such as network operation and maintenance by operators	●	○	○	●	●	○	• Ensure governments' supervision • Government demands can be met first • Fully leverage businesses' experience in construction and operation • Governments and businesses tap their own advantages to mitigate construction and operation risks	• Governments bear construction costs with substantial funding pressure • Governments have to bear relevant risks for being the construction leaders • Businesses have limited control over projects whose resource advantages are not maximal
3	**Government-business JV**	• In the early stage, governments have to provide the necessary funding for the construction of initial infrastructure and formulate relevant policies and laws, rules and regulations • Supported by governments, businesses fully engage in the subsequent construction, operation and maintenance	◒	◒	○	●	◒	◒	• Governments only contribute a portion of the funds with reduced financial pressure • Construction and operation are fully led by operators, reducing the risks faced by governments • Increased control of businesses over projects stimulates active participation by businesses	• Businesses have to bear business risks • The payback period is longer when profits rely on providing business services and value-added services
4	**PPP model**	• Businesses obtain special permits to construct projects and operate them within a given period with self-raised funds and hand over to governments upon expiration • Include BOT, BT, BOOT, BOOST, BLT, PPP models, etc.	○	●	○	●	◔	◔	• Risks faced by governments are reduced as they are less involved in the actual business • The financial pressure of governments is reduced	• Businesses have to bear the construction funds and risks • Profits are not guaranteed during the operation period, thus discouraging businesses' participation
5	**Solely funded by businesses**	• Businesses bear all investments for the construction and operation • Differs from the PPP model in a way that businesses have project ownership without the need to hand over the projects to governments	○	●	○	●	○	●	• Governments do not have to provide funds or bear risks • Businesses have the entire operation and administrative rights over the project, allowing maximization of active involvement by businesses • Businesses' advantages in technology and talent are fully leveraged	• It is difficult for governments to intervene in and exert control over businesses • The network traffic required for public services can neither be guaranteed

Each of the five major operation models of smart city construction is represented by its respective archetypes which will provide reference for participants in the construction and operation in the future.



Model cases

Solely funded by governments

- Government of New York City, United States:
- Provided high-speed Internet access for businesses and residents, and transformed the legacy payphones in New York City into integrated communication facility networks
- Provided guidance on and promoted smart technologies, invested USD3 million in sensors and worked with US Department of Transportation to co-fund USD20 million for the construction of connected vehicle pilots

Funded by governments and operated by businesses

- Barcelona, Spain:
- The municipal government funded the development of electronic systems for elderly care services and patients can use digital healthcare platforms for online consultation, inquiry and making appointments with doctors and specialists
- Department of Health of the Government of Catalonia planned to connect all hospitals and primary treatment centers to the network for medical record sharing by the end of 2017

Government-business JV

- Bonn, Germany:
- Bonn municipal government allocated EUR750,000 together with EUR2.7 million from 200 private businesses and requested for financial support from the state government and EU to construct the smart city.

PPP model

- Wenling, Taizhou, Zhejiang:
- The government franchised applications projects, including the infrastructure construction of the smart city and achieving smart education and smart tourism based on basic systems, to project companies. These companies are responsible for investing, financing, constructing and operating projects and will hand over the relevant assets to government designated units for free after expiration

Solely funded by businesses

- Shanghai Hongqiao Central Business District:
- Businesses or third-party independent organizations with strong comprehensive strengths are responsible for the construction in smart exhibition and smart commerce
- The National Exhibition and Convention Center in Hongqiao CBD offers 1,000M free Wi-Fi
- The newly built commercial buildings in core areas of Hongqiao CBD are fully smart.

Significance

Solely funded by governments

- With more abundant financial funding, economically developed cities may adopt the operation model in which funds are solely provided by governments
- Not all sectors are suited to this model; projects in public security, public transportation and innovation incubators are more applicable to this model
- Governments have to deploy professionals to address potential problems in the subsequent maintenance

Funded by governments and operated by businesses

- With more abundant financial funding, economically developed cities can bear the construction costs
- This model applies to the IoT industry, IT facility construction and social services management

Government-business JV

- This model reduces financial requirements on governments but is limited to developed regions
- The model considers the needs for profit generation by both governments and businesses. Governments have to pay attention to the degree of control over projects to avoid dampening businesses' participation
- Sufficient communication between governments and businesses is guaranteed, thereby reducing the business risks borne by businesses

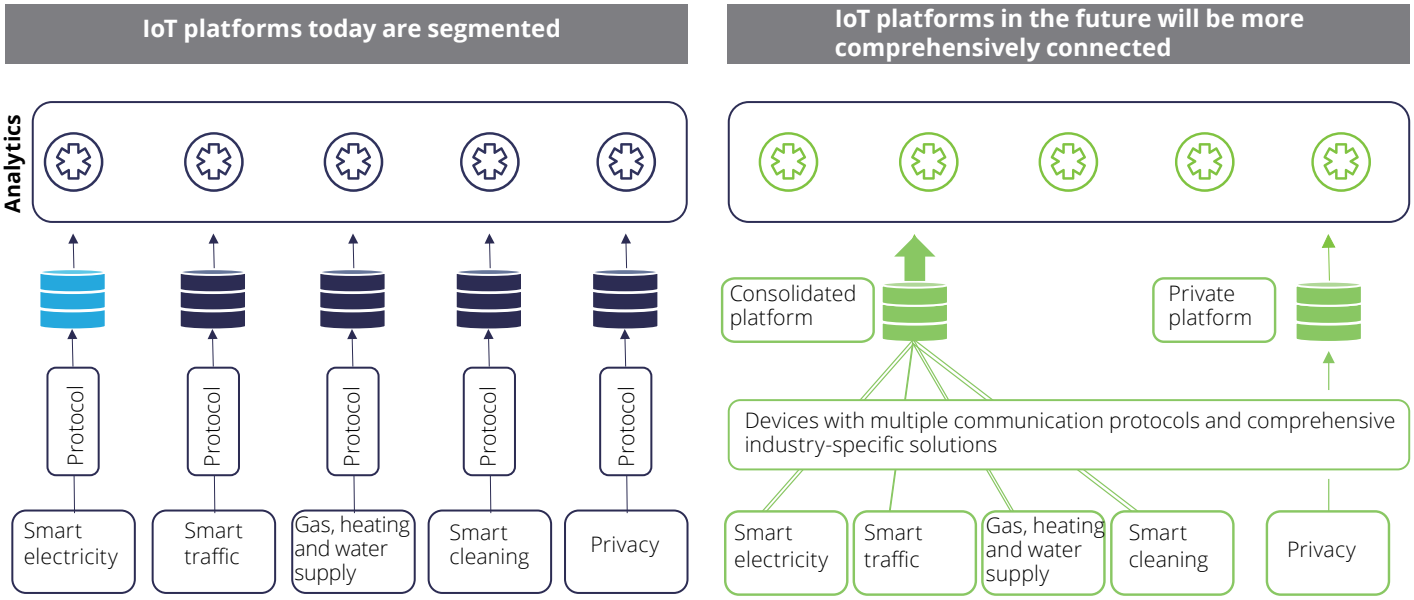
PPP model

- As governments can provide a sound business environment for businesses under reduced financial pressure, cities adopting this model face lower financial requirements
- Sufficient coordination between governments and businesses helps businesses generate profits during operation

Solely funded by businesses

- With limited influence and control over project construction and operation, governments have to strengthen policy restraint
- Businesses with strong comprehensive strengths are much more likely to be able to complete project construction and operation
- As businesses gain profits through projects, their preferred locations remain to be the developed areas with more potential users

4 Super smart city platforms should not cause data isolation.

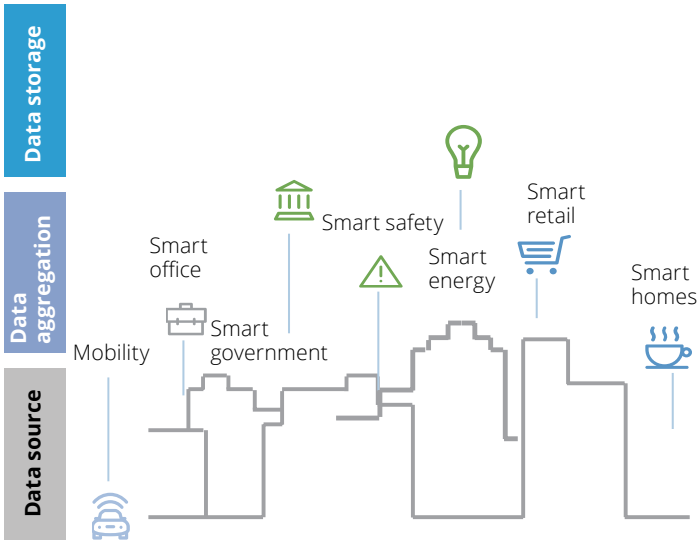


- IoT platforms are segmented because
- platforms apply different protocols and standards;
- devices are very much specialized to capture information in specific characteristics flexibly to a chain that is hermetic to certain applications.

- Developments on IoT platforms indicate a more comprehensive connectivity enhancing the data collection to enable true creation of values.
- The comprehensive connection of platforms owes to consistent data standards and management, as well as the integration of several sensors into one device thanks to technological advances.
- Some applications still require a separated platform, but that would be by design instead of lack of options.

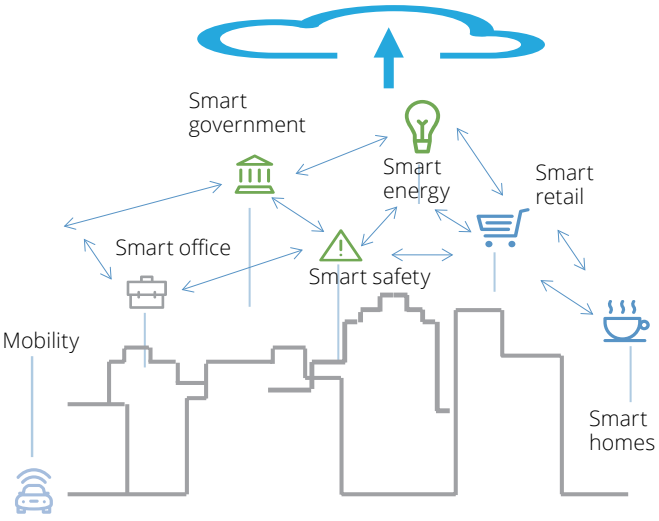
Data of the sectors in the current construction of smart cities are fragmented, but technological and policy advances will break down data isolation and promote data integration in the future.

Currently, data of smart cities are fragmented



- Vast population and widespread Internet infrastructure generate massive data but the data of each sector are fragmented. The data silos result from the fact that:
- as traditional IT systems are operated by different providers and the system standard links were inconsistent, it is hard to connect data among different systems;
- although government departments and business units have massive data, these data cannot be shared due to difficulty in breaking down barriers between departments and units owing to system reasons.

In the future, data of smart cities will be aggregated and stored



- In smart cities in the future, all systems can achieve interconnectedness of data and store data on the cloud. Opening data will break down data silos and generate synergies to build a smart system ecosystem. The data silos can be broken down because:
- mature technologies including big data, cloud computing and AI will provide technological basis for data integration and storage;
- governments step up efforts in promoting the construction of smart cities and leverage policies to drive data integration among different sectors.

By providing technical support, businesses promote the integration and storage of data of government departments in the construction of smart cities.

Technical support from businesses

The IoT uses sensors to connect to the network for data transmission and helps administrators make decisions by further arithmetic processing of the cognitive information. It can be applied in many fields, for example, in smart safety, where sensors are used to monitor public safety.

IoT

Big data

Cloud computing

AI

Big data is the foundation for the AI technology. Comprehensive acquisition, effective processing and deep mining of data helps build smart cities. For example, in the mining of location information in cities, real-time location information is acquired from video surveillance cameras or sensors to facilitate subsequent decision-making.

Cloud computing uses the virtual technology to perform dynamic allocation of computing requests to improve computing capabilities and storage utilization. The need for rapid processing of massive data can be met in the construction of smart cities. For example, data generated from daily life and production activities can be rapidly processed during the construction of integrated smart control service platforms.

AI technology enables the smart development of different sectors in a city through analysis of massive data and machine learning. For example, in smart traffic, AI can predict traffic flow by analyzing massive volumes of traffic data and switch traffic signals to ease the traffic pressure.

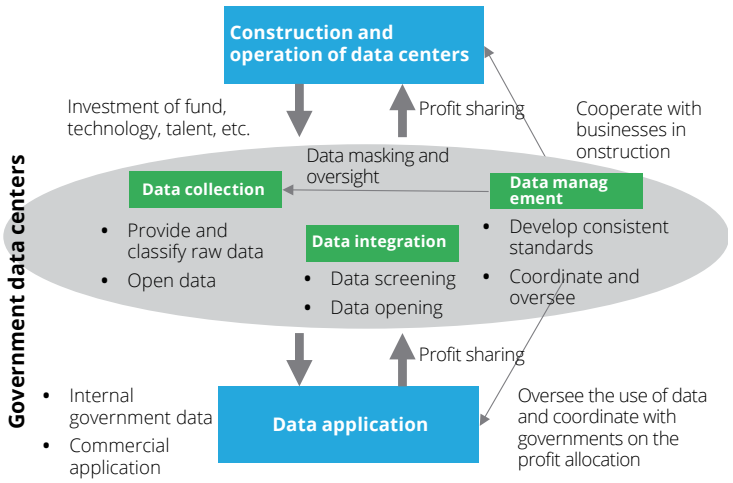
Integration and storage of government data

Barriers to the use of government

- Failure to realize cross-departmental data integration due to integration difficulties from massive and complex information and the fact that data sharing platforms are still in the early development stage
- Lack of commercial use of data and insufficient motivation to combine data
- Lack of sound legal systems related to opening of data
- Other factors: security

Example

- US:
- Laws related to opening of government data are well established and special project management offices are designated to take care of opening of information
- Promote cross-departmental data sharing among government departments by setting up cross-departmental work groups and deploying information administrators within each department



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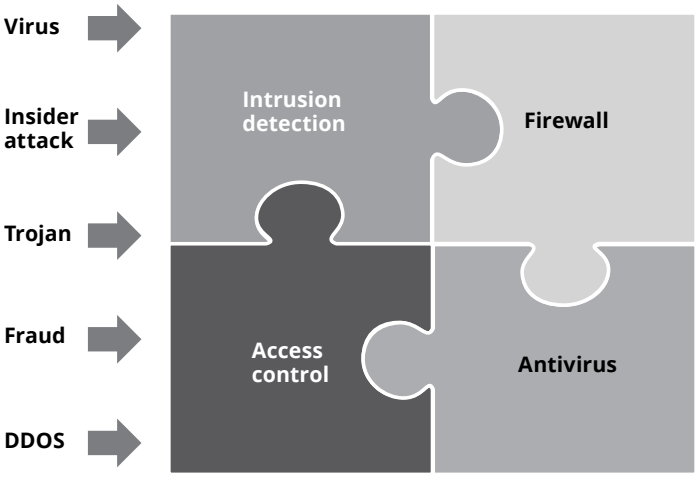
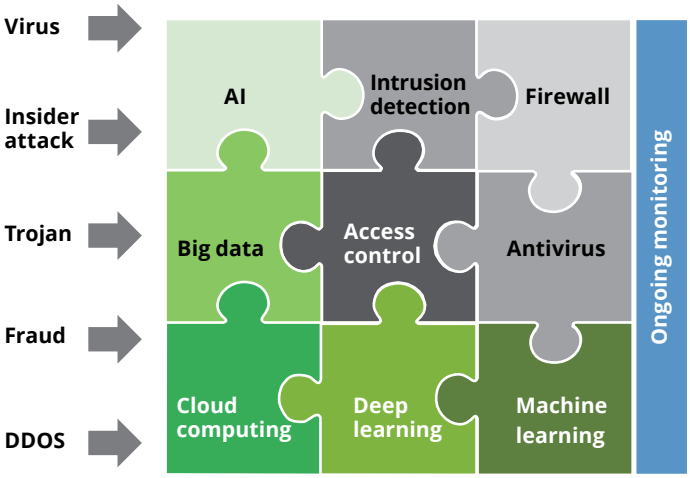
Super smart cities cannot remain passive in responding to data security: by leveraging new technologies, the approach to data security and protection of super smart cities will change from passive protection to active protection and ongoing monitoring will take place.

Today: passive protection



- Currently, data security and protection is passive by taking a post-protection approach, i.e. upgrade virus database and fix bugs after security issues take place or vulnerabilities are identified.
- For example, security software regularly prompts reminders to upgrade virus database, upgrade system and fix system vulnerabilities for operating systems.

Future: active protection and ongoing monitoring

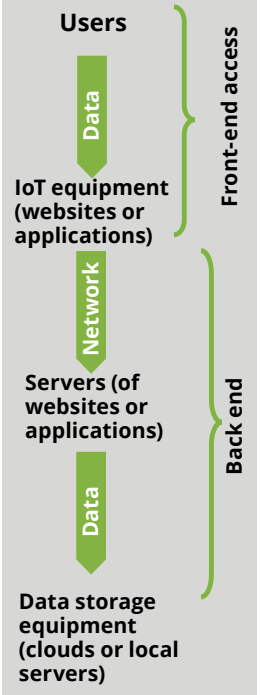


- With the application of next-generation technologies like AI in security discipline, data security protection will change from the passive protection approach to a more efficient and fast active protection approach with ongoing monitoring on security protection technologies and management.
- For example, deep learning technology is used in the antivirus discipline to automatically summarize the characteristics to identify malicious codes rather than upgrading virus database after a virus has spread; in the anti-fraud discipline, machine learning is applied to inspect websites and implement early identification of fraud websites rather than closing illegal websites after a fraud case takes place, and security protection technologies and management approaches are updated in a timely manner to keep track of subsequent results.

As cloud-based data storage in smart cities may easily lead to aggregation of data security risks, the effect of data leakage incidents, once occur, will go far beyond the border of technologies and cities and will have significant impact on economy, politics and society.

Potential cause of threats	Type of threats	Example	Lesson and implication
Technical vulnerabilities	**Outsider attack**	• In 2015, the tax records of about 710,000 taxpayers in the US were leaked. Attackers used users' social security numbers, names and other identity information obtained earlier to acquire tax records via authentication on the website of Internal Revenue Service. • In 2016, ransomware attack hit San Francisco subway system and ticket machines were shut down. • In 2016, hackers attacked Deutsche Telekom, causing extensive network failures and faults of 900,000 routers with widespread limited network access. • In 2016, the computer system of Russia's central bank was hacked. Hackers broke into accounts through fake user credentials and stole RUB2 billion from correspondent bank accounts at Russia's central bank. • In 2017, WannaCry ransomware attack hit the world, including schools, businesses and governments, leading to a loss as high as USD8 billion.	• Network operators need to regularize data development and application, and provide protection throughout the entire lifecycle in parts including data collection, storage, transmission, processing, exchange and destruction.
Management deficiency			• Precisely control the external access to data, define data ownership and ensure the encryption of user data.
New risks from new technologies			• Deploy strict data control and identification systems for data access of internal staff, set reasonable access authorities for internal access, and monitor irregularities.
Increased risks in all parts due to the connecting up of industrial chain	**Insider leakage**	• 69% of companies have had data stolen or attempted to be stolen by internal staff. • Internal staff of e-commerce companies stole personal information related to transportation, logistics, healthcare, social network and banks and sold in online black markets. • Several leakage incidents of client information by insiders have also taken place in the logistics industry, including the selling of accounts and passwords of companies' websites held by individuals to others, malicious programs written for bulk download of client information; the use of several accounts to run batch queries of client information; client information directly exported by R&D staff from the database.	• Develop data masking to effectively guarantee data security and prevent personal information leakage.
Risk aggregation and polarization in data stored in the cloud			• Leverage new technologies such as AI and big data to change the approach of data security and protection from post-attack passive protection to active protection.

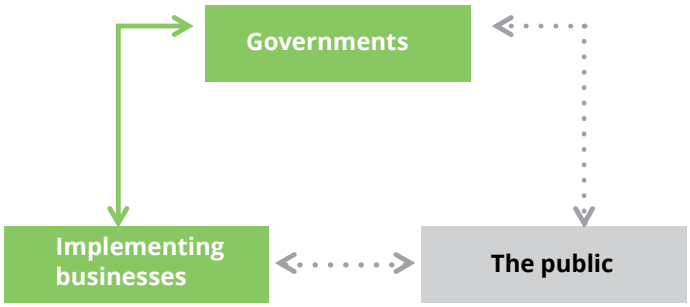
In the construction of smart cities, infrastructure and information resources are important components as their construction effectiveness will directly impact the performance of smart cities, whereas information security, being a supporting system, is the most critical component in the construction of smart cities. With increasing needs for data security of connected digital systems, smart city strategies must include cybersecurity related concepts.

	Potential threats to data security	Solutions	Examples	Transmission process diagram
Data transmission management	• The growing connection among users, applications and data transactions increases the network complexity and security risks • Vulnerabilities exist in hardware (information infrastructure and mobile terminals) and software • Vulnerabilities may exist in network protocols • As 80% of big data transactions involve personal information, businesses and malicious visitors may steal and use personal information • Users lack the capability of access management and awareness of data security • Internal staff steal information via irregularities • External unidentified visitors (e.g. hackers) make use of the above vulnerabilities to hack into the user system via networks or directly steal the information which is being transmitted	**Technology companies** • **Develop integrated security solutions** to minimize the complexity of networks and systems and establish an interconnected and protected system • **Set up reliable software and hardware systems,** fix vulnerabilities, and embed security protection into software and hardware • **Improve encrypted transfer protocols** to prevent user information in businesses' servers from leaking during transmission • **Build comprehensive monitoring systems for data security,** deploy identity services engines to identify the state of cybersecurity, and monitor external threats and internal irregularities in real time to protect urban user data • **Establish comprehensive evaluation systems for data security,** build identity analysis systems targeting irregularities of internal staff, malicious cloud programs, online frauds and external access; provide appropriate access authority to users by class to prevent potential attacks in a timely manner • **Set up threat monitoring and response systems,** prioritize threats and rapidly address data security threats **Individuals** • Individual users need to effectively **manage access authorities** of Apps and mobile devices • Enhance the **awareness of data security**, not to connect to open networks randomly or upload personal private information **Governments** • Governments promote the legislation to protect user data in the mobile networks and sanction illegal acts • Improve the legislation on big data cleaning and anonymization and set up unified standards	• San Diego, US: • The city performs security scanning on data. • In terms of data governance, it acquires information including data locations, visitors, access targets, and verifies information authenticity. • In terms of threat monitoring, the city manages to monitor and respond to real-time attacks. • Finally, all these data are analyzed by a unified platform to forecast and prevent future potential threats.	
Data storage management	• System vulnerabilities and security issues may exist in data access (applications) and data storage equipment on servers (clouds or local servers) • Data storage equipment (clouds and local servers) may be invaded by Trojan, virus, internal staff and external unidentified visitors who would copy and steal the information • Data is also subject to loss (loss of storage equipment, erasure of data, etc.)	**Businesses** • Strengthen the security of servers and hardware systems in data centers, monitor the physical environment of key IT equipment to prevent physical threats, environmental risks or human errors that interfere with IT operation and reduce reliability • **Perform distributed data storage,** dividing files into several data segments for separate storage to improve data security • **Perform encrypted storage** of data in local servers and clouds and only clients can encrypt and decrypt • Promptly remove user private information and data of users that are no longer entitled to access authorities, and destroy the physical storage equipment in a timely manner **Individuals** • Individuals need to strengthen system protection for local data storage equipment to prevent Trojan and virus invasion and the loss of important storage hardware (e.g. memory cards) • Some important information can be stored in cloud platforms for easy threat forecast, positioning and resistance **Governments** • Governments join hands with businesses to build integrated information security systems to prevent data leakage • Governments raise the awareness of data security and data security system planning to prevent leakage of massive data and important information of cities	• Schneider works with the Bank of China Group to build data center infrastructure, protecting business data security with hardware. • Alibaba Cloud initiated the first data protection pact among Chinese cloud computing service providers to call for businesses, governments and public institutions to declare that users have ownership over data.	

6 The participation and cooperation of governments, implementing businesses and the public are vital in super smart cities.

Today: low level of participation by the public

- Active leaders
- Set out policies, laws, rules and regulations, and development plans of smart cities
- Work with organizations and businesses to promote the construction of smart cities

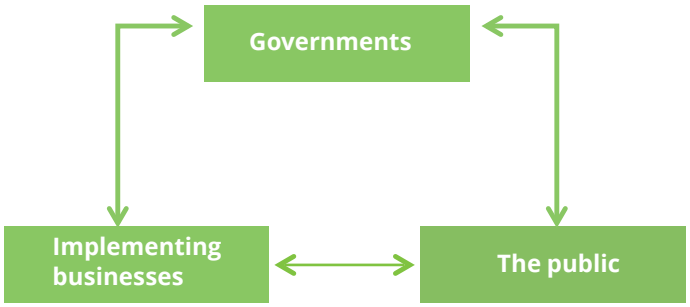


- Main participants
- Work with governments to promote the construction of smart cities
- Provide technology and product support for the construction of smart cities

- Low participation

Future: joint participation by the three parties

- Pacemakers for the construction of smart cities
- Set out policies, laws, rules and regulations, and development plans of smart cities
- Work with organizations and businesses to promote the construction of smart cities



- Primary facilitators
- Work with governments to promote the construction of smart cities
- Provide technology and product support for the construction of smart cities

- Active participants
- Be more likely to participate in service projects in the construction of smart cities

Currently, construction of smart cities is led by governments with implementing businesses as the main participants, while level of participation by the public is low. This is due to:

- the lack of driving factors for the public to participate in the construction of smart cities and low awareness of participation in public affairs;
- exclusion of public participation by government mechanisms;
- insufficient incentive and participation mechanisms to motivate the public to actively participate in the construction of smart cities.

- Governments, implementing businesses and the public will work together to promote the in-depth development of smart city construction, and their respective levels of participation will change.
- Governments will no longer lead but guide the construction, and implementing businesses will change into the primary facilitators from participants which take charge of most projects, while the level of participation by the public will be raised with an improved participation mechanism.

The level of participation by businesses and the public will increase further in the construction of smart cities.

The four roles of governments

Ecosystem builder:

- Build an ecosystem with the participation and cooperation of governments, businesses and communities to create new solutions

Investor:

- Invest in the construction of smart cities through financial funding or collaboration with businesses
- Create a favorable investment environment to promote businesses' investments in the construction of smart cities

Strategic planner:

- Set goals and develop implementation roadmaps for the construction of smart cities
- Facilitate contribution to economic development by smart cities

Policymaker:

- Create a favorable business environment to advance the proposal and implementation of smart development plans
- Develop or amend laws and regulations, and support the growth of businesses while protecting public interest

Increase participation by the public

1. Enhance public participation in multiple ways

- **Build communities/groups:** these groups can either be formed officially or organized voluntarily. Voluntary groups may lower the organizational threshold by support elites.
- **Diversified participation mechanisms:** they refer to games about the construction of smart cities for every citizen to participate in and guiding people of all ages, especially young people to take part in.

2. The role of the public in the construction of smart cities

- **Taxpayers:** as the crowdfunders and crowdbuilders of smart cities, citizens expect governments to make use of the taxes in the most effective way.
- **Consumers:** as the end users of smart cities, citizens expect that their quality of life would be improved after the completion of the smart city plan.
- **Solution enablers:** citizens provide feedback about the priorities and demands to public bodies.

3. Examples:

- **Singapore:** The REACH project receives about 45,000 feedback responses from citizens related to policy improvement, green energy, skill development and education
- **Estonia:** in 2015, Estonia launched the world's first crowdfunding initiative designed to build a smart city with the goal of creating new green technologies. This initiative raised 40% of the total required amount within three days.

Deepen participation by businesses

1. Governments' pressure is reduced with businesses' participation

- Businesses' participation helps facilitate the transformation of governments' functionality in a way that governments may withdraw from the actual project and devote more efforts on the development planning and regulation of smart cities.
- Businesses' investment may help ease governments' financial pressure.
- Fully leverage businesses' own resources including manpower, technology, project experiences to improve the standard of services of smart cities and reduce the construction and operation costs.

2. Businesses' role in the construction of smart cities

- **Technology providers:** deficiencies in technology and infrastructure are key barriers to the construction of smart cities. Businesses specialized in technologies are able to provide smart city solutions by leveraging their own technologies, talents and project experience.
- **Main force of innovation:** technologies applied in the construction of smart cities are all developed and provided by high-tech businesses. Building on the favorable business environment offered by governments, businesses may be able to provide more efficient innovative technologies and solutions.
- **Investors:** businesses' investment would become the main source of funding for the construction of smart cities.

3. Examples

- **Cisco:** planned to invest USD500 million to support digitalization in German, and invested USD1 billion in improving the IoT in the UK in 2015
- **Partnership between Chinese Academy of Sciences and US Sensity System:** jointly developed street lamps integrated with sensors, wireless communication and computer arithmetics to enable sensors on every lamp to store and analyze data and send data about suspicious activities

7

Ongoing and sustainable innovation is vital in super smart cities.

The innovation systems of smart cities in European and American countries are relatively more well-developed; whereas in China, despite having a sound innovation mechanism, their existing super smart cities are yet to mobilize all main components.

Government agencies
- The Beijing government has improved laws and regulations on innovation and start-ups, developed preferential tax policies to boost investment, and increase R&D expenditures to support its innovation system.

Businesses
- Businesses engaging in technology activities in Beijing constitute 25.8%, but business R&D expenditures only account for 36.1% of the total amount in Beijing, resulting in a lack of motivation in innovation by businesses. Also, Beijing businesses have lower conversion rate of achievements. The innovation system of government-industry-university-research integration has not yet been shaped.

Research institutions
- Innovation resources in Beijing are concentrated in research bodies which mainly focus on two areas, namely knowledge innovation and original innovation.

Incubators & science parks
- Beijing's science incubation parks have become an important driver for businesses' innovation. Tsinghua Science Park and Zhongguancun Science Park provide innovation environment, supporting facilities and guarantee policies for innovation businesses and research institutions.

Government agencies
- Since 2010, New York City has invested resources to support startup communities, provided free land and USD100 million of infrastructure funding for applied technology universities, and invested USD2 billion in constructing university parks and startup incubators.

Businesses
- Manhattan builds the Silicon Alley, and businesses like Google, IBM and Yahoo invest in New York City, enabling the technology industry to become the second largest industry in New York City.

Research institutions
- New York brings in famous universities and brings together 10% of the members of the National Academy of Sciences and nearly 400,000 scientists and engineers in the US.

Financial institutions
- New York has seen venture capital boom with a 32% increase in transaction volume of between 2007 and 2011, which accelerated the development of scientific and technological innovation.

Service organizations
- New York is home to a technology conference and 299 technology industry organizations, covering different industries including finance and media, which forms a cooperative industry system.

Government agencies
- Shanghai ranked no. 2 in the state in terms of investment strength of R&D expenditures in 2015, reaching 3.73%, but second to Beijing.
- Shanghai plans to become an excellent global scientific innovation metropolis by 2040, providing convenient access to tax, finance, talent and public services for businesses, and will continue to promote the formation of an innovation system involving government-industry-university-research integration in the future.

Businesses
- In Shanghai's business landscape, state-owned enterprises and foreign companies are predominant and private businesses are weaker, and there is a lack of large Internet technology businesses like BAT. Therefore, Shanghai private technology businesses have run into bottlenecks in conversion of achievements.

Research institutions
- In Shanghai, tertiary institutions are abundant in resources and research institutions are large in number, which mainly focus on two areas namely knowledge innovation and original innovation.

Financial institutions
- Shanghai is a pilot city for the integration of science & technology with finance, such as providing financing services to science and technology businesses (3+X) through microcredit, performance guarantee loan and business credit loan respectively for startups, growth enterprises, little giant businesses, etc.

Government agencies
- Break down barriers to industry-university-research cooperation to enhance collaboration between universities and research institutions and increase efficiency and transparency of their support for businesses' innovation.
- The government invests in the expansion of scale, category and scope of incubators to shape a new environment for urban innovation.

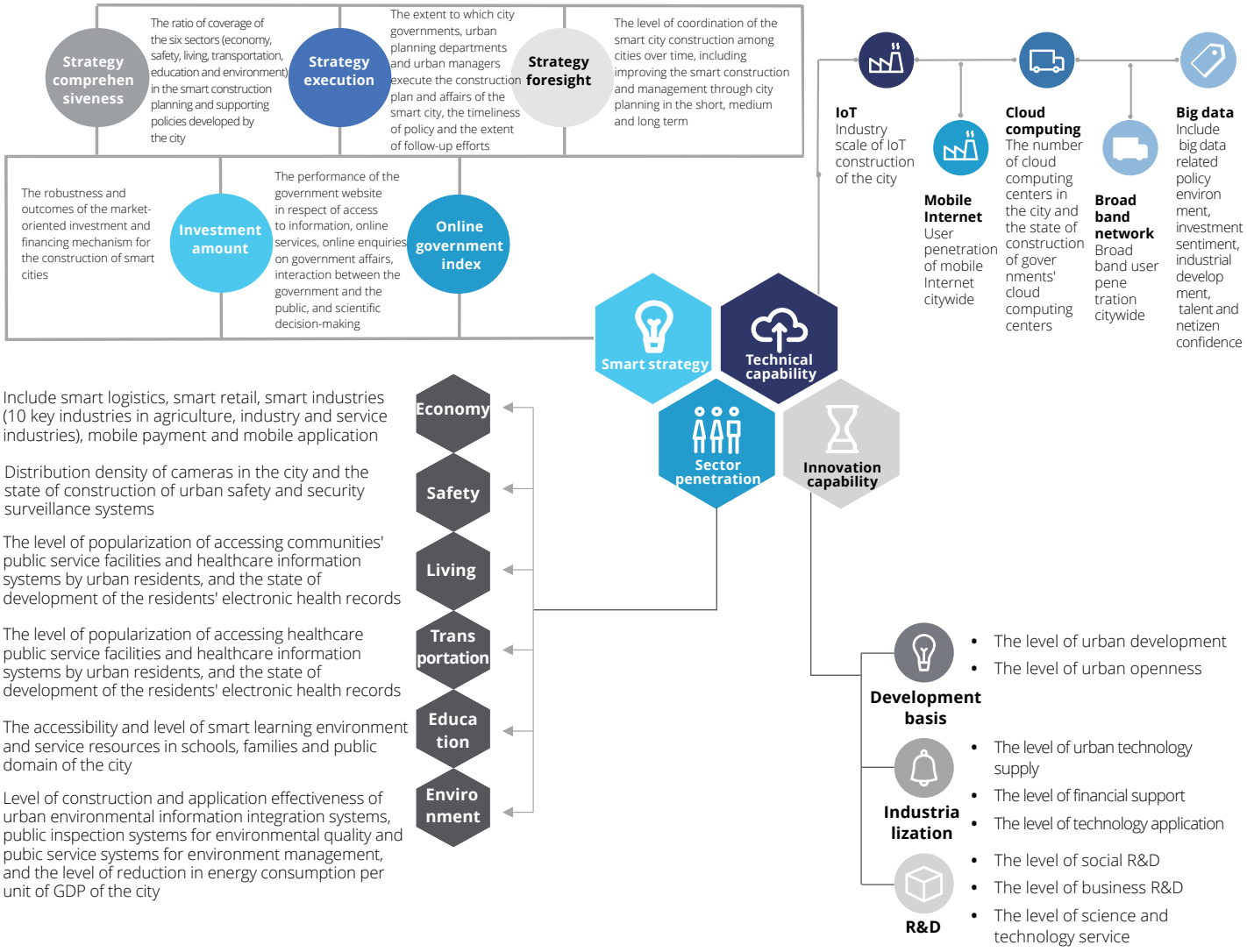
Businesses
- London financial and commercial business clusters are world renowned. Businesses in London account for 16% of the total number of businesses in the UK, and over 100 of top 500 European businesses have headquarters in London.

Research institutions
- London gathers one third of the tertiary institutions and research institutions in the UK and is home to numerous think tanks and scientific research institutes.

Service organizations
- London has a developed science and technology service industry which ranks no. 2 in the country in terms of employment.

Evaluation index system

Evaluation index system for super smart cities



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