



Pre-conference report Smart Solutions for Innovative Cities

IFHP

International
Federation for
Housing and
Planning

INNOVATION CENTRE DENMARK



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Pre-conference report

Smart Solutions for Innovative Cities

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This report is brought to you by Innovation Centre Denmark (ICDK) in partnership with the International Federation for Housing and Planning (IFHP). It is a preface to the "Smart Solutions for Innovative Cities" conference to be held in Copenhagen on 10TH September 2015.

ICDK is a partnership between the Ministry of Higher Education and Science and the Ministry of Foreign Affairs of Denmark. With six innovation centres across the globe and a satellite office in Tokyo, ICDK enables Danish companies and researchers to access the best R&D communities, test and develop their business plans and much more. One of the centre's strongest points is its inside knowledge of the innovation communities and its access to relevant networks.

IFHP is a member-based federation, founded in 1913 in the UK and originated in the Garden City movement. In the 21st century, it has become a worldwide network of professionals covering the broad housing and planning spectrum. The Federation organizes a range of activities across the globe, thus creating opportunities for the right discussion with the right people, matched with a relevant agenda. The IFHP Community is an open community – for those who are interested in and contribute to the IFHP conversation. It is made up of the Council, Board, Office, Members, Partners, Friends and Stakeholders.

INTRODUCTION

In reality there is no such thing as a Smart City.

Attempts to determine a precise definition of the *Smart City* have proved flawed to date because the concept has yet to evolve and remains too fluid. Nevertheless, the momentum generated by ongoing creativity, development and innovation means that there are numerous ideas, projects and attempts to deliver the *smart solutions* essential to the establishment of a *Smart City*. International consensus suggests that there are six key elements:

- **Smart governance**
- **Smart economy**
- **Smart mobility**
- **Smart environment**
- **Smart people**
- **Smart living**

All six features rely on Information Communication Technology (ICT) with sufficient capacity for providing a satisfactory infrastructure for the development and implementation of smart solutions. ICT is merely the mechanism, however, not the objective.

Smart solutions and hence Smart City initiatives can vary according to history, urban development, government strategy and societal structure. Some cities are more advanced than others in this regard and, at present, there is no universally agreed approach. The sharing of knowledge and experience is key to the development of Smart City technology.

This report brings examples of Smart City development from six global mega hubs. Each hub is facing challenges, operates under unique circumstances and is influenced by its local context: culture, national legislation, history and ambitions. Each seeks to use smart solutions to improve the quality of life and establish convenient and intelligent solutions to Smart development.

South Korea is one of the world's most ICT driven and technically proficient countries, Brazil uses data to create a climate resilient, vibrant and modern city. The United States, with little public sector input, is home to private sector driven new technologies, business models and smart solutions. Germany thrives on strong government focus and R&D resulting from partnerships between business and academia. Mobility and energy are key focus areas. China has a roadmap for the integration of smart and green solutions to urbanisation. India is taking its first steps toward the development and use of smart solutions to establish transparent governance, citizen participation and the integration of urban services and utility systems.

It seems that energy and climate efficiency are the priority for the majority of hubs. However, these are familiar to the citizens, companies, NGOs and governments of today. We are all stakeholders, and we need to pay attention to the challenges of tomorrow. We can remain alert by encouraging research and co-creation across sectors and by keeping the international discussion and knowledge sharing alive and healthy. Hence, this report and the conference to be held in Copenhagen on September 10th 2015.

This report points to the fact that ensuring *smart solutions for innovative cities requires smart governance*. The latter embraces stakeholders across sectors, each bringing their strengths to the table: visionary politicians, ambitious businesses, innovative researchers, and citizens who are knowledgeable from a day-to-day perspective. All stakeholders are necessary for the development of national strategies and trialling within a local community.

The Internet of Things (IoT) is also important. IoT is about devices, whether domestic, industry or public sector, being networked with an assigned IP address, thus enabling them to send and receive data without requiring input from users. Forecasts predict that no fewer than 75 billion IoT units will be connected by 2020, making data available to a hitherto unprecedented extent.

The aim of Smart City concepts should be to create better and more sustainable cities for people. Experience shows that projects will succeed when local requirements and local conditions are taken into consideration.

In general, commercial activities with respect to Smart Cities are at an early stage. The sector covers such a broad technological and infrastructural range that no individual, NGO, public institution or private company can deliver full and integrated smart solutions for cities. Another observation concerns the scale of smart solutions in urban development. Innovative solutions sometimes originate in startup businesses or entrepreneurs, leading to a potpourri of small, incompatible and project-based solutions.

Currently, it seems that only the largest corporations are capable of tackling solutions of the magnitude relevant to entire cities. The difficulty is that, though there is considerable interest, very few companies have the capacity and willingness to risk the investment needed for initiatives of the required scale. This presents opportunities as well as challenges for Danish companies and R&D institutions in collaboration with the six mega hubs. The Smart Solutions for Innovative Cities conference is organised to focus our collective contribution towards fulfilment of this ambition:

Together we can develop smart solutions for innovative cities for all.



SOUTH KOREA

Having retained its top ranking in the UN E-government Survey since 2003, Seoul is one of the world's most technically proficient cities.

South Korea is one of the most connected countries in the world. The ultra-fast LTE network (4G) is accessible in most areas. The country's IT & R&D project, 5G mobile communication systems, was established in 2008 and, in January 2014, the government announced its intention to upgrade to 5G by 2020. In October 2014, the major telecommunications companies and the Korean government agreed on a roll-out plan for the 5G network to begin in 2017. Internationally, the European Union and South Korea agreed to cooperate on the development of the ultra-fast 5G in September 2014.

Although a global 5G standard has yet to be agreed upon, the concept of 5G is widely considered to be a set of telecommunications technologies and services that will support 1Gbps per user via super-dense networking.

One of the major telecommunications companies in South Korea, SK Telecom, has been conducting research on 5G networks at least since 2013 and is actively participating in the global 5G effort. The aim is for the world's first 5G services to be commercialised by 2020. 5G is also expected to provide various services and applications that will lead to convenient solutions for both citizens and business and, furthermore, allow for Internet of Things (IoT) interactions.

Key Players in Smart Governance

The Ministry of Land, Infrastructure and Transport has the leading role in taking smart governance forward. However, both the Ministry of Government Administration and Home Affairs and the Ministry of Trade, Industry and Energy are also responsible for the smart governance project and the smart energy and environment policy. Due to the central government's security policy and the strict regulations on personal information, it is not possible to develop public services that will allow for a more direct exercising of democratic rights such as digital voting systems, access to public forms and application processes. However, the development of smart governance tools has a high priority and new legislation on the transfer of personal data for applications such as e-health or e-banking is on the way.

Local governance

Although local governments work separately and have some autonomy when it comes to urban development, the more large-scale decisions are made by the central government. These include major investment projects, the creation of special zones or industry hubs, as well as citizens' rights and responsibilities. After a central government decision and/or allocation of investment, the actual implementation relies on local government. Currently, the Seoul Metropolitan Government (SMG) is promoting and operating an e-Governance initiative which represents Seoul's digital strategy for sharing and harmonising processes between citizens, the public administration,

data and disaster management (natural phenomena). The e-Governance is divided into three major categories: G2C (Government to Citizens), G2B (Government to Businesses), and G2G (Government to Government).

Use of Data

Government 3.0 is a new government-operation initiative aimed at promoting the active sharing of public information and removing barriers between government ministries for the purposes of enhanced collaboration. The ultimate goal is to deliver the driving force for national administration and to provide personalised services to individual citizens while also generating more jobs and supporting a creative economy.

One of the current government’s keywords, Big Data, will include two-way and personalised communication between citizens and government.

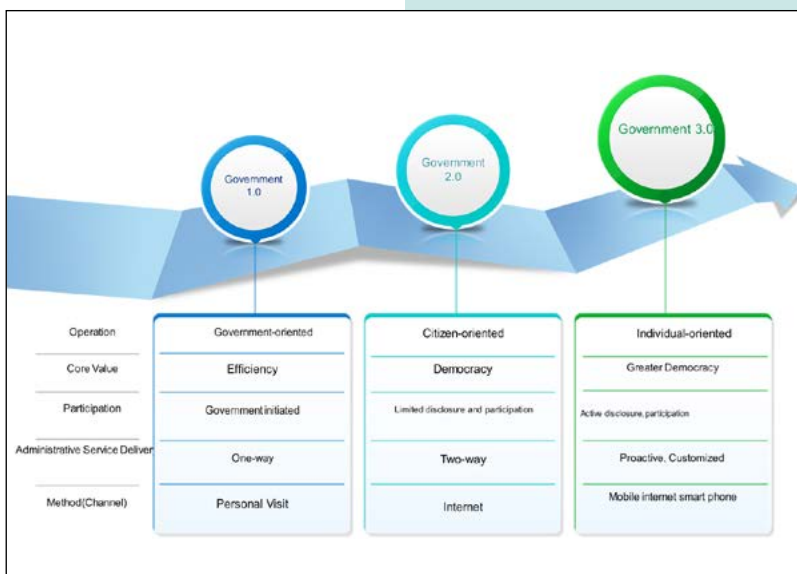


Illustration: Korean Government 3.0 (Ministry of Government Administration and Home Affairs)

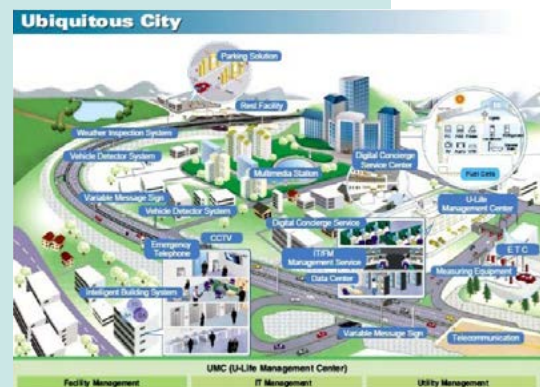


Illustration: <http://www.urenio.org>

In Korea, the U-city concept is more widespread than the Smart city.

U-City

The Korean government passed a law regarding the construction of a Ubiquitous City (U-city) in 2008. This law mainly concerns IT, a technological factor, a spatial factor and urban development and has legal force with regard to the construction of the U-city combining technical and spatial statutes.

In order to facilitate the ICT based urban development market of developing countries, the Korean U-city concept has been developed in a way that is slightly different from the Smart City concept, which originated in the US and Europe. While the U-city is effectively driven through ubiquitous systems in new cities, the Smart City equivalent is through physical, intellectual and social capital in existing cities.

In Korea, the U-city concept is much more widespread than that of the Smart City.

A new U-city is being established in Songdo, a district of Incheon, located on an island some 40 miles from Seoul. Songdo is attempting to realise a more developed concept of sustainability.

Although this city model is still a project, it could well be one of the best solutions with respect to creating an intelligent management of our communities. It could, for example, be the way ahead for public institutions to control water consumption. In this regard there are high expectations for the project. Similarly, it is hoped that the new cities will increase electricity savings, introduce electric public transport and improve recycling systems.

Under the Creative Economy Initiative of the Park Geun-hye administration, the public sector is fostering an environment that supports R&D in national smart projects. The five key areas are as follows:

- **Smart Transportation – ITS (Intelligence Transport System), Navigation, and Smart Highway**
- **Smart Water**
- **Smart Grid**
- **Smart Infrastructure**
- **Smart Building and Housing**

The Smart Highway

The Smart Highway project uses a new technology called the “wave” which uses and thus communicates hazards to motorists. Those in danger of falling asleep while driving or otherwise crossing into another lane will be alerted via a message from the radar system. Drivers can also use the system to pay tolls or obtain real time traffic conditions through the system’s Wi-Fi connection. Roads and car radios will be able to exchange real time information on traffic conditions and detours for avoiding heavy traffic. The road surface will also use advanced materials to better discharge run-off and reduce noise.

Korea’s “Smart Highway Project”

Project Period	2007-2014 (7 years)
Builders	Korea Highway Corporation + 67 agencies
Budget	\$ 78.7 million
Government (funding)	\$ 57.8 million
Private (funding)	\$ 20.9 million

Source: Smart Highway R&D Center



Photo: <http://www.asiaicardforum.net>

Radar systems installed in roads for the purpose of detecting problems.

BRAZIL

Using data to deal relevantly with current climate and social challenges to create a resilient, vibrant and modern city.

In 2009, the newly elected local government in Rio de Janeiro was facing significant challenges as one of the most violent communities in Brazil. Politically and economically these included having the poorest health and primary care capacity in the country and frequently being subject to natural disasters.

However, with the hosting of the World Cup in 2014 and the Olympics in 2016, Rio de Janeiro has seized the opportunity to kickstart technology investments and develop strategies for moving the city towards smarter solutions. The local government strategies have focused on Rio's poorer communities while investments have been directed toward the lower end of the social scale.

A key force behind Rio de Janeiro's change has been Brazil's rapid adoption of mobile technology, which has transformed both private and public communication across much of the country and allowed ICT to take off in new areas at a remarkable speed. Today, Brazil has 282.6 million mobile-phone users, or 1.39 per citizen. They are quickly making a transition to the newer technologies conducive to mobile internet use. By combining and enabling access to big public data, cities such as Rio de Janeiro are moving quickly towards the implementation of smart solutions in cooperation with and in connection with their citizens and their personal smartphones. Rio de Janeiro was elected the Smart City of 2013 by the Smart City Expo World Congress and, in 2014, the city was placed among the 21 Most Intelligent Communities by the Intelligent Community Forum.

Governance

Brazil is a Federal Republic. Although Smart City policies are primarily promoted at state and municipal levels, the federal government has, for the past decade, been behind the implementation of initiatives that have laid the foundations by boosting innovation and promoting digital inclusion. This encompasses programmes for direct investments or loans, innovation projects in the private sector, and tax incentives for private companies that invest in research and development.

Resilient Rio – a local governmental strategy

Rio de Janeiro has recently published its *Rio Resiliente* strategy, which aims to monitor progress and assist the city in its preparation for the future. *Rio Resiliente* primarily concerns risk evaluation with an extra focus on climate as well as social and economic factors. 10 major risks were identified:

- **Heavy rainfall**
- **Strong winds**
- **The Urban Heat Island effect**
- **Rising sea levels**
- **Local and pandemic outbreaks**
- **Prolonged droughts**
- **Accidents involving the urban infrastructure**
- **Congestion of the road network**
- **Influx of people impacting on the normality**
- **The incidence of crime in the urban area**

The identification of these risks enables Rio's Operations Centre to plan its actions in more efficient ways. The *Rio Resiliente* strategy's decision-making process is supported by a managing committee comprising representatives from the Mayor's office, the Civil Defence service, the Municipal Secretariat of the Environment, the Secretariat of International Relations and COPPE-UFRJ, the institute of postgraduate courses in engineering from the Federal University of Rio de Janeiro.

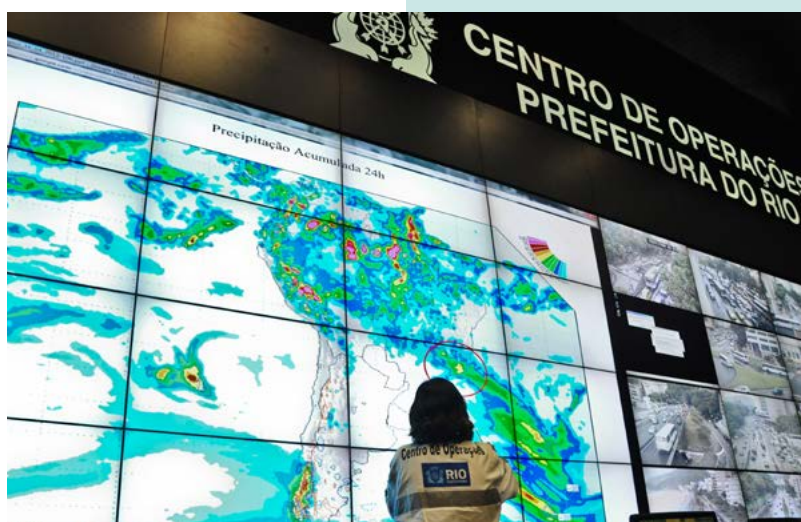


Photo: George Soares



Photo: George Soares

Integrated Big Data tools were set up in Rio de Janeiro.

The Rio Operations Centre

In order to implement *Rio Resiliente*, Brazil's most complex, integrated Big Data tools were set up in Rio de Janeiro. The Operations Centre was initially a part of the 2016 Olympics Plan. However, following a series of floods and landslides in 2010, in which dozens of people were killed, and hundreds left homeless, the local government decided that it was necessary to advance its plans. The Rio Operations Centre was established in just eight months.

Basic features

The Operations Centre monitors the city round the clock, seven days a week, and collects data from some 30 bodies (municipal and state departments and essential service sectors). The Operations Centre provides access to several layers of geo-referenced information. A significant proportion is derived from real time data collection, providing information on, for example, public transport, tidal levels, traffic management and the energy grid. The data comes from data sensors and crowdsourced information provided by citizens' smart phones. The Centre operates both on a daily basis and during crises and major events. It acts as integrator for all the public services organisations and as both facilitator and "toolbox" for these agencies.

The Operations Centre covers areas such as information technology, watershed management, traffic management, waste management, street lighting, geology services and tourism. The public authorities and agencies involved comprise the Municipal Guard, the Department of Public Order, Department of Conservation, Department of Health, Department of Social Services, Civil Defence, the Military Police and the Fire Department. Added to these are a number of providers of essential services such as the companies responsible for gas, water and power supply, subway, railway and buses.

Organisation

The Rio Operations Centre represents a huge organisational shift and a complete change of mindset in terms of how to deal with public management through smart solutions and technologies. Departments now work integrated and coordinated in order to facilitate significant cross-disciplinary work and optimise the city's response to disasters while improving the citizens' quality of life.

The Centre's functional organogram reinforces the model of integrated work as opposed to a hierarchical structure. The integration of different entities and sectors is related to the *Community Warning System*.

The Rio Operations Centre is built on cutting-edge technology. The Control Room, the heart of the project, can produce any combination of data. Over 400 professionals working over three shifts, use video streaming from 550 cameras, in addition to another 350 cameras from utility concessionaires that are also connected to the centre. All the information is set out on a smart map, which has over 120 data layers. The Crisis Room ensures rapid, effective decision-making in emergency situations, and it is equipped with an innovative telepresence system. Similar facilities were installed at the mayor's official residence and at the Civil Defence service. The Press Room shares the flow of information and data to citizens through a variety of media. Moreover, the Centre encourages citizens' participation and involvement via integration of its data and operations with different apps.

Community Warning System

This was established by the Geotechnical Institute, which identified the communities at high risk from landslides. Currently, 103 communities have over 160 sirens installed, and more than 190 "support points" have been set up. Mapped communities have around 7,000 representatives, trained by the Civil Defence service, who act in emergency situations until the arrival of technicians.

The system uses mobile phones donated by the municipality to community agents, who receive a text message alerting them in the event of rainfall or changes in meteorological conditions. In critical situations, sirens will also be used; and, with the assistance of the warning tone and pre-recorded messages, Civil Defence officials will advise residents to leave their homes and go to a secure "support point" defined in advance.

The Health Secretariat is also part of the project. All citizens with special needs and in particular those with physical disabilities in the participating exposed communities have also received a mobile phone. In critical situations, each community agent will be responsible for one individual citizen with special needs and for helping him/her to the support point.



The Civil Defence of Rio De Janeiro

SMS warns about heavy rainfall or meteorological changes.

Traffic management

Traffic is one of the main challenges facing Rio de Janeiro and it is also one of the prime focus areas of the Operations Centre for this reason. A number of initiatives have been implemented in order to reduce traffic congestion.

Traffic management initiatives

1. The integration of data and operations with different apps with one of the most successful integrations being Waze – a social GPS helping drivers to find the best route in terms of traffic density.

2. BRT – Bus Rapid Transit consists of exclusive corridors for high capacity buses. Two have already been established and a third is planned to be ready by the end of 2016. The BRT corridor is like a surface metro, with the advantage that the costs and time required for its construction are considerably reduced compared with the construction of a metro.

3. BRS – Bus Rapid System consists of the creation of segregated lanes for buses and taxis during days and periods with heavy traffic. The bus stops were reorganised, and the information systems were standardised throughout the corridors. According to CET-Rio, the BRS corridors reduce the travel time for buses by about 25%.

4. Rio-Bike Capital is a strategic goal for the municipality. It comprises the implementation of 450 km of bike tracks in the city. A private bike sharing system was implemented in 2010; it already comprises 200.000 users and is expanding.



Photo: Divulgação/Centro de Operações

Traffic is one of the main challenges in Rio de Janeiro.

Financial Sources & Structures

Brazil is currently facing severe economic challenges and public authorities in general lack sufficient competences and coordination to assume control of and administer financial resources to effectively overcome the emerging urban challenges. Resources and funding are, nonetheless, available from a number of different sources.

Programmes at a federal level, such as the “Growth Acceleration Program” (PAC) and the “General Union’s Budget” (OGU) will fully cover all areas in Smart City projects, through state funding as well as resources provided by multilateral financing institutions, such as the “Inter-American Development Bank” (BID).

Yet, federal financial institutions, such as the “National Bank for Economic and Social Development” (BNDES), Caixa Econômica Federal (CEF) and research and development agencies tend to give preferential treatment to projects involving infrastructure issues rather than governmental, management, and social issues. Private funds from equity, bank finances, and financial markets take the same view as they tend to favour infrastructure related projects and support few, or even no other issues.

Open data

In Brazil, developments in ICT and the prevalence of smartphones and internet connections in general constitute a huge potential for the development of new smart solutions and businesses.

The Open Data Committee of Rio de Janeiro is part of the municipal administration and is responsible for ensuring that data is made accessible to citizens as part of a transparency policy, adopted for the purposes of ensuring improved environments for journalists and supporting the Rio Operations Centre.

In 2014, a department called PENZA (Think) was established with its primary responsibility being to manage and analyse the Big Data initiatives launched by the Municipal Government and to come up with creative solutions for the city.

Having decided that data should be made available to the public, the City of Rio has initiated a process of open government and open government data, giving the public access to a website on a daily basis to check data on traffic jams, weather conditions, pollution, crime rates, and other information.

In addition, Rio has a number of open data portals, each representing one of the three generations of open data. One has three datasets in fully open formats, and it focuses on providing interactive access to data via Geographic information system (GIS) technology. Aimed at coders and programmers in Rio, Rio Datamine is primarily intended for enterprises and startup users for the creation of applications. The portal's aim is to develop apps that can help improve the development of the city with respect to, for example, education, health, transport, housing, environment and culture. Rio Datamine is a centralised, open data portal with thousands of datasets from secretariats, agencies and departments – all in the comma separated values (CSV) open data format. The data here includes tourist and cultural points/places, hotels, academies for the retired, bus stops and routes, municipal schools and health establishments.

USA

Silicon Valley presents a paradox: Smart City infrastructures are few, yet new technologies, smart solutions and business models, are abundant.

Since his inauguration, President Obama has launched initiatives in order to transform the US as well as the government into a modern 21st century digital society. The new strategy is motivated by surveys showing how Americans, especially in rural areas, have been late-comers with respect to technology and the internet but are now increasingly online because of mobile devices. It is predicted that more Americans will access the internet via mobile devices rather than desktop PCs over the course of 2015.

Government initiatives and policies include investment grants, totalling \$3.4 billion, dedicated to Smart Grid projects such as promoting energy-saving choices for consumers, increasing efficiency, and fostering the growth of renewable energy sources such as wind and solar. The grants were part of the Reinvestment and Recovery Act that was a response to the global economic crisis. The grants follow an industry matching model, meaning that every private investment made will be matched by federal grants.

Development is driven by private companies and challenged by an infrastructure that is largely outdated, as is a considerable part of the grid.

Local governance & technological strong points

With the speed of urbanisation escalating across the entire United States, cities are looking at ways to become “smarter” and more flexible in order to be able to respond to future citizens’ needs, including accommodating habits of living, working, driving, and interacting with each other.

One of the most prominent trends is leveraging the technologies arising from the Internet of Things (IoT). This is experienced in Silicon Valley as well; with the area being home to many of the biggest IoT-players worldwide. The area is currently seeing many new startups in this field. In Smart Cities, IoT can assist them in using their resources more efficiently – improving everything from air and water quality to transportation, energy and communication systems.

SFpark uses sensor technology (smart parking meters) and wireless communication technology to collect and distribute real time information about the number and location of available parking spaces in San Francisco. SFpark operates as an information service in its own right and also makes its data available as an API for use by public

and private developers. SFpark uses demand-responsive pricing to open up parking spaces for each block, thus reducing circling and double-parking in congested areas.

San Jose has, in collaboration with Intel, been driving an initiative, where the focus has been to develop solutions for benefiting the city through the use of IoT and, thus, support San Jose's Green Vision. The collaboration has resulted in the application of Smart City solutions for everything from air and water quality to traffic and parking management to communications systems and other city infrastructure aspects.

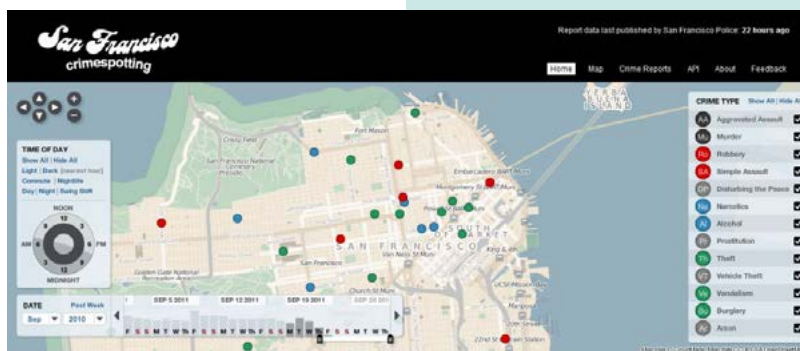


Photo: IFHP



Photo: IFHP



Available apps responding to citizens' needs.

Urban & digital infrastructure

The San Francisco infrastructure is not particularly advanced when it comes to reliability of the grid. Power outages are fairly frequent and, with utility lines above ground, it is unstable. Moreover, it poses potential danger for people living in the city. Just 7.7% of the citizens have fibre internet connections in the US, while San Francisco ranks as low as 208 out of 408 cities in terms of connectivity.

Progress *can* be observed, however, and San Francisco has partnered up with Google to provide free Wi-Fi on Market Street. In addition, the city has recently set up free Wi-Fi in its 32 public parks. San Jose has launched similar initiatives and also boasts free Wi-Fi in much of its central area.

One area where San Francisco is at the forefront is with the implementation of smart water meters to control and visualise water usage. The city's Public Utilities Commission has installed 180,000 smart water meters, the highest number in the country.

Financial sources

Most activities related to Smart City projects in the Bay Area originate in the private sector, leaving little focus on publicly funded programmes. In 2012, 74% of all projects were privately financed, with the remaining 26% being outsourced.

Research & technology in Silicon Valley

The US is the home of many of the world's leading universities. Furthermore, all the foremost Smart City technology providers are located in Silicon Valley – either headquartered or with large R&D divisions. Also, technology companies, such as Cisco, Google and Tesla, contribute heavily to research on different aspects of the Smart City concept.

The combination of the two – namely world-class academics and cutting edge technology – has fostered an entrepreneurial mentality among the students and faculties in the area, which has led to patents and business startups. Business and university research into Smart Cities is mainly technology-oriented, focused on innovation and new applications. The many startups focus mainly on apps, social sciences and business models, with Uber representing just one example.

The main players in Smart City research are Stanford University, UC Berkeley, Babson College, California Institute of Technology, and – last but not least – MIT. In addition, a number of companies have noticeable university-industry collaborations and startup accelerators.

Research areas

Autonomous vehicles at Stanford University. One example of a research project has been intelligent sensing methods to ensure that cars keep to their own lane.

Autonomous vehicles with traditional and new industry players. The entry of software companies marks an interesting transition in business models. Also, Uber's recent poaching of many researchers from the Carnegie-Mellon Robotics Institute emphasises how research and new ideas seem to constitute a winning strategy; with industry knowledge playing a much reduced role as the entire sector changes.

Traffic data and smart grid at UC Berkeley. One of the university's current projects is about smart transportation, using anonymised cell-phone data logs (Big Data) for the purposes of adjusting mobility demand models. This is exposing the need for smarter traffic solutions.

The Demand Response Research Center (at Lawrence Berkeley National Laboratory) **is a large smart grid centre**, focusing on an array of fields, including the potential of electric vehicles as electricity storage resources for a number of grid applications, fast demand response, wholesale ancillary services, communications & standards, and a test bed for smart meters, including larger home appliances.

Multi-modal transportation at Massachusetts Institute of Technology. One area of focus is on shared-use vehicle systems, on the development of new vehicles especially for urban environments, including electric scooters and bike-lane vehicles.

The public transport agency in the San Francisco Bay Area has invested in a car-sharing programme, serving more than 16,000 citizens in the Bay Area: most of them from low-income neighbourhoods. More than 50% of the fleet is battery-based and 200 of the cars are located within walking distance of public transit hubs.

The Mineta Transportation Institute at San Jose State University focuses on the **future of transportation**, primarily on rail, bicycles and sustainability, as well as on socio-economic and policy issues.

Test beds in lighting performed at the California Lighting Technology Center at UC Davis. A Smart Lighting Initiative, including a 1500 LED streetlight test centre, which has led to an 86% reduction in energy consumption on exterior lighting. The research division focuses on all aspects of lighting, including technology, buildings, and policy recommendations to the Californian Energy Commission.



Photo: <https://ddl.stanford.edu/>

Commercial activities

San Francisco and the Bay Area are known for IT and technology-driven companies, many of which are global leaders. A considerable number have participated in the foundation of the Smart City, as they have commercial interests in the digital infrastructures that are becoming the new standards worldwide.

Many Silicon Valley startups are tackling new consumer applications, whereas the big technology companies are trying to figure out how they, too, can tap into the segment. There are three main trends in relation to Smart Cities:

The Internet of Things (IoT) is the technological development where all devices have an assigned IP address and networking connectivity which allows them to send and receive data without requiring user interaction. Forecasts predict that, by 2020, no fewer than 75 billion IoT units will be connected, thus pushing the development of city integration. The decreasing prices of sensors as well as improved wireless and cloud-based solutions have enabled the rapid absorption of the technologies into everyday life.

Big Data is a consequence of the many new devices being connected and hence more data created. New technologies are able to capture data in real time and enable operators (or intelligent systems) to react instantly. Such cloud-based data has created exciting opportunities for economical extraction of insights from large volumes of data and providing in-depth analyses of the many different sectors of a city. Such vast amounts of data have obviously prepared the ground for a wealth of new business opportunities, a development that has also been acknowledged by the city.

Smart mobility and infrastructure exerts an impact on the transport sector, which can be viewed from a number of perspectives:

- The automotive industry was damaged in 2008 by the global crisis leading to new strategic focuses **among existing players**
- **New players entering the industry**, such as Tesla and Uber, focus on alternative mobility solutions and business models
- Newer Silicon Valley tech companies focus on the **integration of sensors, networked communication and computing hardware**, as well as software pertaining to the physical infrastructure
- **Digital transportation**, where different solutions are currently disrupting industries and making traditional transportation obsolete
- **A new era of transportation and mobility** in the city, similarly to what can be observed with respect to other sectors such as retail
- **Intelligent traffic systems** place increasing demands on the automation of different components and user-created input
- **Connected transportation** where cars, systems and commuters are interconnected works when all entities are online and enabled to deliver data input in real time

Investments

One of the primary reasons why so many new ideas and companies are emerging from Silicon Valley is the corporate and venture capital available in the area. In 2014, Silicon Valley accounted for 30% of all settled investment deals made in the US, totalling \$22,628 billion or 45% of the VC invested.

Public debate & use of data

The Smart City sector is primarily driven by the strong private technology sector, with each of the companies trying to capture market shares. Hence, only very few non-government organisations participate in joint programmes. One exception, however, is the Smart Cities Council. A partner-led association for the advancement of the Smart City business sector, the Council promotes Smart Cities in general. The degree of involvement of participating cities is decided by the individual members, and little collaboration exists between the cities.

As many of the largest Silicon Valley companies live and breathe data, the buzz around Big Data was born in this area. Many new startups are entering the field, tackling nearly every industry that uses data.

In general the US public debate on Big Data is diverse. On the one hand, many companies consider Big Data to be a major business opportunity, whereas consumers are reluctant to surrender too much data, as they generally distrust both companies and authorities who collect data about them. Many also consider Big Data to be a solution to many of the problems faced by cities; and the more data available, the better the solutions that can be found. This is also why cities and authorities are opening up their public data to be tapped into by companies and citizens and, thus, provide better solutions.

San Francisco and San Jose have both created open data catalogues.



Photo: <https://data.sfgov.org/about>

Cities and authorities are opening up their public data to provide better solutions.

Open data catalogues

SF Open Data is a platform for companies. The city opened up its data back in 2009, and was one of the first cities in the world to do so. The initiative has six specific goals on how to use open data for the purpose of improving developments in the city and its surrounding area. Also a wide variety of city departments publish their data. The city has also employed a Chief Data Officer, and all departments have Data Coordinators to make sure things are pushed forward. In 2011, San Francisco had 211 open data points for people to tap into.

The San Jose Open Data Catalogue is the next generation of civic transparency meant to encourage and inspire the innovative spirit of entrepreneurs, civic hackers, residents and businesses. It is designed to encourage collaboration with the authorities in the pursuit of optimised efficiency and to improve the lives of the citizens through strong and safe communities. San Jose currently has 185 open data points.

CHINA

A roadmap has been drawn up and positive steps taken towards the integration of smart and green technologies in Chinese urbanisation, acknowledging that multi-sector coordination is essential to success.

China is currently undergoing the most rapid urbanisation process in its entire history, with around 18 million rural populations having migrated into cities each year for the past 4-5 years. By the end of 2014, the total urban population had reached 750 million, accounting for 54% of China's population, with this number expected to grow further in the years to come. Both impacts and challenges of urbanisation are acknowledged at the national level. The central Chinese government has therefore developed a roadmap to create an intensive, smart, green, and low carbon urbanisation path.

The need for further sustainable and green development is urgent. In the past 5-10 years, the Chinese central administration has been looking into Smart City pilot projects for cities across the nation. The use of data and IT infrastructures are key components in driving their development. China is moving on to the next stage, evolving from infrastructure to application focus. The use of data is challenging because of restrictive policies, security issues concerning the use of data, and a lack of skills with regard to the management of large data sets.

Governance & major policy makers

Since 2011, the Smart City concept has been an integrated element in the national strategy, against the backdrop of sustainable development. The 12th Five-Year Plan (FYP), setting out the overall national economic policy for 2011-2015, explicitly calls for a strengthening of the Smart City technology sector and encourages continued development. Key ministries jointly support the Smart City technology and industry development. Most of the support is in the shape of R&D funding, Smart City alliances and pilot projects, albeit without any marked coordination.

Smart City initiatives and policy frameworks

Since 2012, one government initiative, the Smart City Pilot programme, has contributed with valuable test beds for exploring various Smart City business models. It has thus created a substantial change in the shaping of the Smart City development strategy in China. After three rounds of calls for pilot projects, the number of Smart Cities in the country is close to 300 and comprises major cities as well as second and third tier cities and districts. This programme has been rolled out with the support of investment funds totalling RMB 100 billion made available by the China Development Bank. In the implementation stage multi-sector coordination has proved essential as the Smart City

scope goes beyond any single sector and requires intensive information sharing and integrated actions. The governance of China could advantageously be transformed from closed and linear to an open and collaborative system — a challenge to the conventional Chinese form.

In this context, the Chinese central government has called for a healthy and robust development of Smart Cities to be focused on quality and real impacts. At central government level, efforts are being made to improve coordination. Eight ministries jointly issued “Instructive Opinions on a Robust Development of Smart Cities” in 2014. This set of opinions highlighted four guiding principles on which to establish Smart City development in China, namely that it must be:

- 1. Human centred**
- 2. Local needs oriented**
- 3. Market driven**
- 4. Security controlled**

This further stresses the need to enhance Smart City planning, with focus on meeting citizen needs and on providing efficient and low-cost public service.

The smart green city – integrated concepts and merging boundaries

In China, the Smart City and the green city are separately defined concepts that will serve the new urbanisation pathway together. The Smart City covers widely scoped and multi-technology sectors. In China’s national policy, Smart City development will evolve in the following six directions:

- **ICT infrastructure development**
- **Information-based urban planning, e.g. the creation of urban GIS databases**
- **Smart living applications**
- **Efficient public service**
- **Smart and specialised governance, e.g. the application of ICT technology**
- **Modernised industrial development**

Meanwhile, at the national strategy level, China has strong ambitions to build a green and sustainable society. A Smart Green City concept has also been introduced in some cities where both modernisation and low carbon emissions are taken into consideration.

Shanghai local governance

By the end of 2014, the population of Shanghai reached 24.2 million. This figure represents just the permanent residential population. The city is estimated to house an additional 7-8 million immigrants. According to a survey undertaken by China’s Ministry of Industry and Information Technology (MIIT) in 2013, Shanghai is the Chinese city boasting the most advanced ICT system, in particular in the areas of internet preparedness and ICT application. Being a mega city, Shanghai is facing tremendous local challenges in terms of resource affordability, economic development and governance, as well as global challenges such as climate change. For these reasons, both sustainable development and modern urbanisation are high on the local Shanghai government’s list of priorities.

The Smart City policy of Shanghai has gone through two major stages:

After the initial phase, where focus was on infrastructure construction, such as ICT technologies, to form the backbone of Smart City implementation, the Shanghai municipality moved to its second Action Plan which sets out an intensified locally focused and better defined strategy for the development of Smart City solutions.

Stage 1 Focused on ICT infrastructure development

In 2010, Shanghai's government issued its Action Plan to Promote Smart City Construction in Shanghai 2011-2013. This Action Plan was aimed at the establishment of an advanced ICT infrastructure, an efficient and smart application system, an innovative ICT technology industry, and a reliable regional information security system. Stage 1 supported the industrial development of Shanghai's "4-centre" strategy, namely to make Shanghai into a national economic, financial, trading and maritime centre.

By the end of 2013, the majority of the targets set out in Action Plan 2011-2013 had been achieved. The city also collected experiences in data security control. Against this background, the Shanghai municipality issued a new Action Plan to Promote Smart City Construction in Shanghai, 2014-2016.



Photo: <http://www.smartcitychina.com.cn/en/>

**Shanghai is hosting
the Smart City
Expo&Congress,
November 2015**

Stage 2 Lived Shanghai

Emphasises smart applications more intensely targeted on local needs. The "LIVED Shanghai" concept sets out five overall targets for the establishment of a liveable urban environment, innovative industries, viable urban management, and efficient governance through realisation of district projects. Under these five headings, the Action Plan sets out 28 special target actions, covering nearly every aspects of urban life:

- Action 1** To build a habitable city with accessible and affordable smart living for each citizen, reflecting the most predominant challenges to the daily life of the citizens of Shanghai
- Action 2** To develop a high-end smart economy based on innovative industries
- Action 3** To build a viable and specialised smart urban-management system
- Action 4** To achieve transparent, efficient and integrated smart governance
- Action 5** To set up a new Smart City landmark, through realisation of district projects

Research and development

In the field of Smart Cities, at both national and regional levels, R&D programmes are designed to encourage indigenous innovation in support of the development of domestic technology, products and enterprises.

At the national level, the Ministry of Science and Technology (MOST) has launched two rounds of Smart City R&D funding programmes. Most of the projects are required to have enterprises as lead applicants. With respect to 5G technology, this is open for international applicant companies and encourages international collaboration.

Talent pool - R&D prioritised stakeholders

Talent and expertise is the key to Smart City R&D. The Shanghai municipality is actively attracting and training talents in the field of Smart Cities by:

- Building a domestic and overseas **high-level talent pool**
- **Training and educating specialists** in smart industries via university, academic and industrial collaboration
- **Offering favourable policies** to attract and retain high-level talents and industrial leaders

Commercial activities

In the 12th FYP period (2011-2015), investment in Chinese Smart Cities is expected to amount to more than RMB 1.6 trillion. As an element in the strategic development, Chinese Smart City projects are often top-down, i.e. led by the government and driven by policy directions. The market is often created within certain policy frameworks. Even so, this approach can be efficient and achieve significant economies of scale; and the Smart City pilot programme has demonstrated that there is no common solution for different cities.

In general, commercial activities around Smart Cities are at their very early stage. With a 90% urbanisation rate, Shanghai is at the forefront with regard to market exploration.

The size of the future Chinese Smart City market is however tremendous, and the full potential is far from fully exploited. The market will continue to grow and be attractive to both domestic and foreign companies. As the Chinese market matures, the entry and market penetration of foreign companies will require more clearly defined strategies, consistent technical strongholds, sufficient local information and multi-channel collaboration with local companies.

Independent stakeholders, the public debate & the use of data

Due to the centralised governance structure, Chinese policies concerning urban planning and sustainable development are, in general, top-down. Overall, public participation has been a weak point in decision-making processes. In recent years, various efforts have been made to engage multi-stakeholders, including NGOs and the general public. Changes are two-way. The government has realised the necessity of, and benefits from, enhanced transparency and, on their part, citizens are calling for increased participation in public affairs. The efforts are realised by way of information disclosure, raised public awareness, policy advocacy and community initiatives.

NGO activities have exerted various impacts in China. However, it should be pointed out that NGO activities are heavily regulated and closely monitored. The legitimacy of NGOs in the country, particularly non-government backed NGOs, is often questioned. In many areas, this curbs NGO initiatives targeted at more fundamental transformations.

Public Debate

Earlier and better public participation in urbanisation processes can enhance government accountability and ensure that policies respond to local needs. Public participation in China, however, is so immature that even limited participation is often based on group interests rather than on citizen rights. In many cases, people are pushed to engage in the protection of their essential well-being, instead of becoming involved as participants.

In general, the official channels for public participation or consultation are limited in China. However, owing to the emergence of social media and internet coverage, public opinion finds expression in unforeseen ways.

One particular area, in which to improve public participation, is uninterrupted public information disclosure and open data. Access to the right information is crucial to constructive public debate. In both national Smart City policies and in Shanghai's Smart City action plans, the government has highlighted the development of open public data as key to Smart City implementation. This could potentially lead to higher levels of public involvement in city governance and public affairs.

Use of data

The ownership of data is fundamental for data accessibility and application. Currently, the majority of government service related data belongs to a wide variety of authorities and public agencies. Although the Shanghai municipal government has called for open data and data-sharing in different areas, coordination among different authorities and agencies still has a long way to go.

Private companies are striving to access non-sensitive civil data as their initial foray into the market. To achieve this and, more importantly, access to the business related data, both domestic and international companies are developing their own strategies for closer cooperation with local authorities.

Working against the development of the Smart City concept, however, the Chinese government currently ranks data security as top priority. The concern over the disclosure of sensitive data and the threat to national security has entailed increased scrutiny of foreign companies.

Financial sources

As an alternative to conventional government-controlled funding, public private partnerships (PPP) have recently emerged as a means of financing public projects.

In 2014, the Ministry of Finance published a guidance on "promoting the cooperation of public and private capital", in which a PPP is defined as a long-term partnership between government departments and private investors in infrastructure and public services. In this, the private sector is responsible for the design, construction, operation and maintenance, while the government is in charge of public-service pricing and quality control.

There have also been examples of the involvement of foreign capital in PPPs. In 2002, the Shanghai Water Authority thus entered into an agreement with the French Veolia, an international waste, water and energy management concern, to form a joint venture, namely Shanghai Pudong Veolia Water Co. The intention has been to use foreign expertise to build a modern enterprise and, also, to increase management efficiency.

Challenges & Opportunities

The need for an even more sustainable, green and Smart City development is urgent. Chinese urbanisation is challenged by the continuous influx of migrating workers from rural areas and the major environmental issues resulting from heavy air pollution, water consumption and energy system overload.

Research and development in Smart Cities, including smart grids, is supported by the Chinese government, and the collaboration between the academic world and business enterprises is key to drafting developments and projects. As the R&D programme is heavily supportive of indigenous innovation, foreign companies and academic peers are obliged to cooperate closely with local partners if they wish to be part of research and development projects.

It is expected that Smart City projects will come to play increasingly major roles in the great Chinese cities such as Shanghai. The challenges for entering the Smart City

market in China are associated with the accessibility to public data as well as the increasing competition from domestic Chinese companies. The collaboration and dialogue with authorities can be both resource intensive and difficult. Nonetheless, the support from foreign companies, especially in the field of smart, sustainable and green urban solutions will continue to be a major requirement in China.

City Services created by the use of WeChat

WeChat, developed by Chinese company Tencent, is an instant messaging app that was developed in China in 2011. With approximately 450 million active users in Q1 2015, this is by far the market leader within instant messaging in China. Over the years, this application has been further developed and today it also contains a social network aspect. People can share photos and status updates, known as "Moments", alongside voice- and video calls. Together with several other innovative features, there is a payment module which allows the transfer of money between friends, the booking of taxis or cinema tickets, and payment for food at a number of restaurant chains.

In 2015, the WeChat developers collaborated with Shanghai Municipality in bringing the so-called "City Services" to the users of Shanghai. With this update, WeChat users can now renew their passport, check the status of their driver's license, pay for public utilities and traffic fines, book long-distance train tickets, report incidents to the police, reserve library books, monitor air pollution, watch traffic camera live feeds and several other features, all within the confines of their instant messaging app.

The most innovative feature is, however, medical-treatment services. By teaming up with the Chinese medical service platform Guahao.com, WeChat users in Shanghai can now seek expert consultation, book hospital appointments, receive test reports, query prescriptions, pay for medical services and follow up on diagnoses with regard to further consultation or treatment.

The medical treatment services have been provided as a tryout period in the cities of Guangzhou, Shenzhen and Fuzhou, where average user waiting times have been cut by 1-2 hours, thus addressing a crucial problem in Chinese health care where unstructured registration processes have entailed long waiting times.

The use of online services and apps to bridge the gap between users and public entities, thus bringing otherwise offline services onto an online platform, is not a new concept. Many countries have several apps facilitating citizens' interaction with libraries, hospitals, public transport, tourist services, etc. However, bringing these services to the users by embedding them in an instant messaging and social media app, which the vast majority of Shanghai citizens are already using lifts the digital-city infrastructure to a new level. Not only does the solution combine all the new digital services provided by the municipality in one place, it also brings them to the users in a form with which they are familiar and which they are already using on a daily basis – thus potentially leading to faster adoption.



Photo: Tencent, from the app "wechat"

Smart City concepts are essentially human-centered and should meet local needs and local conditions.

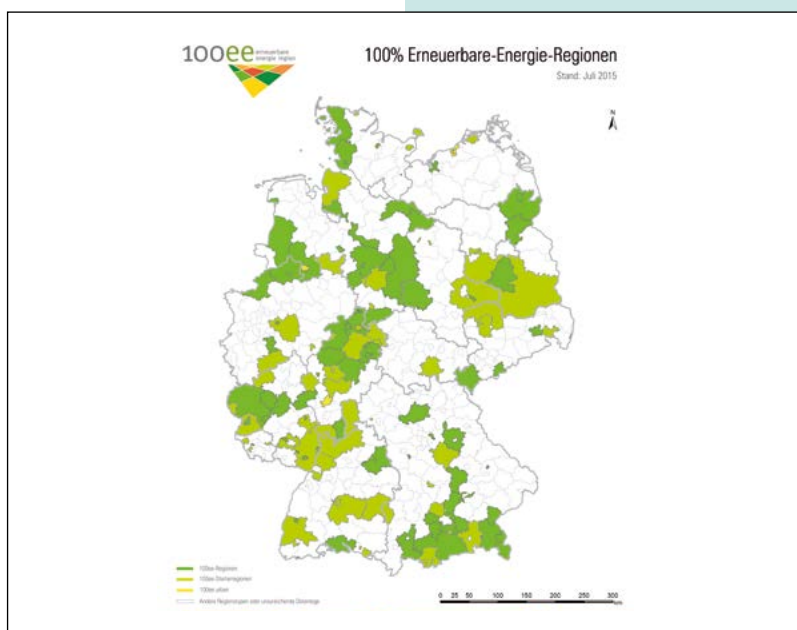


Photo: <https://www.flickr.com/photos/carloszgz/15798574506>

GERMANY

A strong government focus combined with private industry and academic R&D. Mobility and energy are key focus areas.

The German federal government is highly focused on the *Smart City*, which has considerable impact on all 16 federal states in the country. For the last decade, sustainable growth has been a major public concern – one closely connected with the federal government’s 2010 plan to phase out nuclear power. This will require a fundamental transformation in the nation’s energy landscape and it also poses significant challenges to the operation of existing energy infrastructures. “Efficient Energy Use” plays a crucial role in Germany, and many German municipalities/regions have set themselves goals of Renewable Energy self-sufficiency (RESS). This potential can be significantly improved through intelligent use and networking between innovative research technologies and pilot projects.



The map shows the German cities that have been most active in their efforts to become 100% self sufficient in renewable energy.

The German government's "Future Megacities" programme is furthering the development of energy and climate-efficient structures in emerging megacities across the globe. The goal of the initiative is to create the best sustainable urban development practices that involve both decision-makers and inhabitants, in order to deliver performance and efficiency gains in energy production, distribution and use.

"Elektromobilität" (e-cars) is another major focus area for the German government. It is expected that Germany will have one million e-vehicles by 2020, and hence will have become a leading provider and market for electric mobility.

A key objective in the German high-tech strategy and its 2014 Digital Agenda is the expansion and development of broadband roll-out in Germany. Figures from January 2012 show penetration and growth rates to be above the average for the EU.

Local governance and initiatives

Many federal states have their own strategy and regulations with regard to the Smart City, and each major German city has its own specific area in which it is striving to develop and strengthen knowledge, expertise etc.



Photo: shutterstock_157079105_Sean Pavone

Politicians at Munich City Hall are one of several key players in the alliance to promote Smart City concepts.

Munich is the capital of the German federal state of Bavaria. It has the lowest crime rate in the country and more multinational corporate headquarters than any other German city. It is also the global HQ of Siemens, one of the major multinational players at the forefront of the Smart Cities revolution. Munich is not just a city for multinationals, however, it also provides good conditions for startups. It is undergoing constant development as increasing numbers move there. The need for housing is planned in such a way that new buildings and neighbourhoods will be self-sufficient with regard to energy. Likewise, areas and buildings are constructed with a view to becoming net producers of energy so that other Munich neighbourhoods can benefit from such set-ups.

Munich has a range of projects and action plans, and there are three pillars to its Smart Urban approach:

- **Smart Economy**
- **Smart Living**
- **Climate protection**

The list below is a brief description of several projects and actions plans, concerning the three elements noted above:

- **Housing construction** – energy-efficient construction in existing and new buildings
- Urban development, urban **land-use and landscape planning**
- **Mobility and traffic**, planning and managing the infrastructure
- **Energy-efficiency** in industry and in the city administration
- **Energy generation and distribution**, low-energy street lighting and traffic signals
- **Energy management** in city-owned properties and in the infrastructure

The members of and partners in the alliance are key players in business, science, politics and NGOs.

The scope is to identify, develop and implement replicable, balanced and integrated solutions in the energy, transport sectors; and to undertake ICT initiatives through partnerships. The challenges are that the projects need to be realised in 2-3 cities or communities (lighthouse cities or communities), including industry and city planning authorities. They should also reflect the view of consumer organisations, research communities, as well as local small and medium-sized enterprises (SMEs).

Collaborating with the city-owned utility company, Stadtwerke München (SWM), Munich's 2025 goal is to be able to produce sufficient green electricity at its own plants to meet the power requirements of the entire municipality – meaning at least billion annual kilowatt hours (kWh). This would make Munich the first city in the world with more than 1 million inhabitants to achieve such a goal. Through these undeniably ambitious, yet achievable targets, the city is taking on a pioneering role and is at the forefront in terms of climate and environmental protection.

Research and development

Germany's innovation and research landscape is rich and diverse; and it is characterised by a high level of integration and collaboration clusters among research institutions, private as well as public, and the industrial sector.

The Haus der Forschung institution, for example, supports research and innovation in Bavaria and was set up in 2010 by two Bavarian ministries: Economics, Technology and Media; and Science and Higher Education. The objective is to establish science, SME and industry consortia and to have an overview of eligible funding and advice in technology.

Another body, Fraunhofer, Europe's largest application-oriented research organisation, is at the forefront of Bavaria's research on energy and Smart City domains. Fraunhofer's Competence Center, FOKUS, is involved in all ICT-intensive aspects of Smart City research, including E-government, E-health, Public Safety, Smart Mobility, and Smart Energy.

Get an overview of specifies selected Fraunhofer activity areas with respect to Smart Cities on the following page.

The Bavaria R&I landscape

- 9 universities
- 5 university clinics
- 23 fachhochschulen (university colleges)
- 17 universities for applied sciences
- 12 Max Planck institutions
- 3 Helmholtz Centres
- 5 institutes from Leibniz Association
- 6 Fraunhofer institutes incl. Fraunhofer HQ

Activity areas

- **5G R&D**
- **Network Functions Virtualisation** for software implementation on top of ordinary hardware architectures
- **Future Internet & Internet of Things**
- **The FOKUS Open eXtensible Service Platform (OpenXSP)**, – a platform to provide an environment for the combination of M2M and human-to-human communication services in one cloud
- **Service Environments**, evolving network architectures, best-in-class services and convergence requirements
- **STREETLIFE**, – a multimodal urban mobility information system providing end-users with mobile information services on sustainable transport alternatives



Electric car at a charging station
Photo: Shutterstock

The support and enthusiasm of citizens is crucial for Smart City initiatives to succeed.

Public debate & the use of data

The public debate concerning Smart Cities has many different players and is of great concern to large sections of the German population. In Bavaria, the issue of increased civic involvement has been addressed by various initiatives. It has become clear that the support and enthusiasm of citizens is crucial for Smart City initiatives to succeed.

Taking into consideration that Germany has very strict data policies (due, in part, to World War II historical reasons), the general population is cautious. Large parts of the country's inhabitants are against the use of open data. The government thus lacks citizen support in its desire to pursue open data and data sharing. Hamburg and Berlin are pioneering Germany cities in the debate on this and data sources.

The Berlin Open Data Strategy (BODS) was developed by Fraunhofer FOKUS to ensure reliable third-party access to public data. It was designed to increase collaboration and transparency, and to facilitate participation by Berlin residents. The portal facilitates sharing, analysing, and the further processing of data by a range of services. Thus, businesses, organisations, and citizens have free access to innovate and develop new services. The Berlin Open Data portal, launched in 2011, was the first of its kind in Germany.

Over the past few years, Fraunhofer FOKUS has been researching solutions for Smart Cities in cooperation with its partners in industry as well as in public administration. The newly created Centre for Smart Cities (part of Fraunhofer FOKUS) is home to leading experts in Information and Communication Technologies who are ready to tackle today's real-world Smart City challenges. Reference scenarios illustrate how solutions (e.g. government mashups for transparent civic participation and smart metering for

a more efficient handling of energy resources) can improve life for citizens, public and private enterprises, and for urban administrators.

Financial sources

The total German GDP expenditure on education and research and innovation is EUR 79.9 billion (2015), equal to 2.853% of GDP. Two thirds of this are from industry. GDP allocated to R&D in higher education is EUR 14 billion with 82% being publicly funded, 14% from the private sector and 4% being internationally funded. The largest part of the R&D budget, approximately EUR 3.9 billion, is allocated to natural sciences and mathematics research.

The municipality of Munich has several examples of PPPs. Geodata management is a mobility example. The necessity for local geodata management has become more and more evident because of the increasing complexity of the mutual interdependence between geoinformation and improved technical possibilities. Munich needed the right technology to manage the increased availability of digital geodata, so a PPP was established. Similarly, the municipality participates in PPPs in green energy and, for example, house building and energy-efficient construction.

Mannheim: Smart City

Mannheim: Smart City, aimed at linking every household in the city to a smart energy network. The solution was to heighten the efficiency within energy provision and raise awareness about energy among inhabitants. The case increasingly focuses on terms of accessibility, quality of life, communication and social municipal structures. This has brought about a change in city planning, creating strategies such as the Smart City concept.

Link: <http://www.dac.dk/en/dac-cities/sustainable-cities/all-cases/energy/mannheim-smart-city/>

The purpose is to improve life for citizens, public and private enterprises, and for urban administrators.



Photo: [Cases/energy/mannherim-smartcity/](#)

INDIA

India's urbanisation can with the appropriate use of smart solutions establish transparent governance, citizen participation and integrate urban services and utility systems.

India is urbanising at a rapid speed. Around 400 million people out of a 1.2 billion population live in cities already. The number of urban dwellers is expected to increase to approximately 800 million by 2050. The number of towns/cities in India rose from a little over 5,000 in 2001 to almost 8,000 in 2011. This growing urbanisation is putting a strain on the country's basic infrastructure. Urban service systems are rarely coordinated, and this entails many unforeseen and negative effects on the quality of urban living all over India. Thus, according to the WHO, India holds the dubious distinction of hosting six of the world's 10 most polluted cities.

During the Indian parliamentary election campaign in 2014, a programme aimed at creating 100 Smart Cities by 2019 was proposed. The idea is to provide a modelling platform for improving the standards of urban living in India as well as the processes of planning and construction of urban settlements. In late 2014, the Indian Government published a Draft Concept Note on a Smart City Scheme outlining a process towards the identification and implementation of the 100 Smart Cities Programme. The "Pillars of a Smart City" and, hence, the objectives of the programme are defined as follows:

- **Institutional Infrastructure:** The governance, planning and management of a city is made participatory and incentivised through new technology.
- **Physical Infrastructure:** Cost-efficient and intelligent physical infrastructures such as mobility system, energy system, water supply system and others are all integrated through the use of technology.
- **Social Infrastructure:** The development of human and social capital through education, healthcare and inclusion of marginalised groups is promoted through ICT-supported delivery of content and services as well as the local provision of physical facilities.
- **Economic Infrastructure:** A city must create an infrastructure for providing employment opportunities through the identification of: 1) local core competence; 2) local comparative advantages and; 3) the local potential for economic activities. Subject to this identification, the gaps in the economic infrastructure can begin to be filled through local facility building.

Additional programmes under the collective heading of Atal Mission for Rejuvenation and Urban Transformation (AMRUT) will be targeting the infrastructural requirements of existing cities. Over the next five years, the AMRUT programme will reach out to 500 cities. It will focus on the completion of unfinished infrastructural projects from a previous programme as well as initiating new projects in water management, transport and the development of green spaces.

Financial structures

The financing of Smart Cities and AMRUT cities in India will be achieved as follows:

- **Smart Cities:** The Indian Government has granted the equivalent of DKK 50 billion to finance the programme from 2015 to 2019. Each Smart City will receive approximately DKK 0.5 billion for the entire five-year project period.
- **AMRUT:** The Indian Government has granted the equivalent of DKK 52.5 billion to finance the programme from 2015 to 2019. Cities with fewer than 1 million inhabitants will receive a grant of 50% of the project costs. Cities with more than 1 million inhabitants will receive a grant of 33% of the project costs.

The funding is channelled to the state governments and the Urban Local Bodies of the designated cities.

The use of Public-Private Partnerships (PPP) is encouraged by the Indian Government. Private companies have been invited to present PPP models, i.e. Build-Operate-Transfer, Build-Own-Operate-Transfer, Build-Own-Maintain, etc. PPP model incentives are subject to negotiation with the relevant Indian government ministries and appropriate departments in the Central and State Governments.

The main challenge in India remains the governance structure for providing information on Smart City development. The integration of Smart Cities in the overall urban structure of the country may also require thought and research. The task at hand is to avoid the Smart Cities becoming islands in a vast sea of dysfunctional infrastructures. On the other hand, opportunities include the many possibilities to leap-frog existing infrastructural boundaries through the full exploitation of the open data/open source systems available to secure integrated and intelligent flows of information in the Smart Cities.

Local governance

It is impossible to discern an overarching trend in terms of local policies for Smart Cities in India. Since basic infrastructure and the corresponding ICT systems for the enabling of the governance and management of urban livelihoods represent basic challenges in most Indian cities, the issue of project planning and execution naturally has priority. The fact that a PPP-based project model has been envisaged by the Indian Government may provide the impetus for a more sustained focus on delivery. However, as long as the details remain on the drawing board, its effect remains unknown.

New Delhi has been mentioned as the location for up to three demonstration cities to illustrate various themes of Smart Cities. The Delhi Development Authority will oversee the projects, which are conceived as PPPs. The private partners will construct the cities' buildings, whereas the Delhi Development Authority will facilitate the infrastructure, defined as: road network, sewage/water treatment plants and green spaces. A Memorandum of Understanding with Spanish partners has been entered regarding technical support for urban planning and management, infrastructure, water management, housing, waste treatment, mobility, energy and utilities, sanitation, environment and public goods and services.

Infrastructure

New Delhi can be characterised in the following way:

Digital infrastructure:

- **Internet connectivity is generally available**
- **High-speed internet is available**
- **Coverage is universal**
- **No smart grid plans as of now**

Urban infrastructure: in general, the New Delhi urban infrastructure is not connected to the digital infrastructure.

- **Water management is basic:** Waste water is mostly untreated, the water table is rapidly falling due to unauthorised tapping of ground water, while the level of non-revenue water is high. During rainy spells, flooding is a common phenomenon, due to insufficient drainage.
- **Public transport network:** The Delhi metro system functions well; public road transport is basic.
- **Energy management is basic:** Power cuts occur on a daily basis during the summer period (April-July) and less frequently during the rest of the year.
- **Green spaces:** New Delhi has a fair number of green spaces and parks, but the maintenance level is generally low.
- **Waste management is basic:** Waste is generally handled without treatment.
- **Roads/traffic:** With some 7.5 million cars, the New Delhi traffic is intense with serious rush-hour jams. During the evening/night, lorry traffic is heavy. In general, traffic regulations are ignored, leading to reduced road safety.

Public organisations in urban planning

- **CEPT University**, Ahmedabad (Gujarat). CEPT=Centre for Environmental Planning and Technology. Faculty of Urban Planning (www.cept.ac.in/faculty-of-planning) – CEPT’s focus is on planning tools/processes in urban settings
- **Indian Institute of Management** Bangalore (Karnataka), Centre of Excellence in Urban Governance (<http://www.iimbernet.in/centre-public-policy/research/centre-excellence-urban-governance>) – IIBM is focused on the development of urban governmental/digital infrastructures
- **Urban Research Design Institute**, Mumbai (Maharashtra) (www.udri.org) focuses on the design of solutions for urban infrastructure/services
- **Indian Institute for Human Settlements**, Bangalore (Karnataka) (www.iihs.co.in) – focuses on urbanisation policy research



Photo: Shutterstock

The Delhi Metro functions well and is efficient.

Research & development

In India, research on human habitats and urbanisation – including the integration of infrastructure with technology – is focused on the challenges posed by the frantic growth of Indian cities.

Urban planning and urban governance can be highlighted as two important areas for research, since it is widely acknowledged that the outcomes of the Smart Cities and AMRUT programmes will hinge on the solutions to be designed for transparent governance, citizen participation in decision-making and the integration of urban services and utility systems. The issue of coordination between decision-makers, public agencies, private partners and urban communities is of considerable concern in this respect. Important research institutions that work with these aspects include: Research in the field of ITC-based integration of urban services and utilities is carried out at several Indian universities and research institutions and by think-tanks. Research is solution-targeted and increasingly focused on the coordination of information and delivery systems. Key research institutions in this field include:

- **Indian Institute of Science, Bangalore (Karnataka), Centre for Infrastructure, Sustainable Transport and Urban Planning,** (<http://cistup.iisc.ernet.in/>)
- **National Institute of Urban Affairs, New Delhi** (<http://www.niua.org/research-themes>)
- **The Energy and Resources Institute (TERI), Sustainable Habitat Research Area, New Delhi** (www.teriin.org/SH)

Commercial activities

Smart City solutions have so far been restricted to the initiatives of multi-national companies (MNC) and large Indian corporations. The international companies have addressed the Smart City agenda from the point of view of their potential contribution to the ICT infrastructure needed to operate a Smart City. SMEs are not seen to be participating in the discussions to any discernible extent.

The establishment of industry standards, reference frameworks and models to guide the activities of private corporations is a key concern and has been discussed by government representatives and industry itself. In this context, industry representatives have assumed the role of providers of solutions in which environmental concerns are reflected. The issue of PPPs in an Indian context features prominently in discussions between industry and public sector/government representatives, since a PPP model has yet to be designed and prior experiences with PPP in India have been viewed with mixed feelings. The Indian government's strategy for Smart Cities projects also includes PPPs – and the fact that projects will not be 100% government funded is intended to incentivise PPP involvement in the projects.

Public debate & NGOs

The current debate in India is not so much about solutions since, in principle and from a wider perspective, the consensus is that the ITC-driven Smart City infrastructure is the future, both in terms of governance and sustainable public service delivery. The more important topic seems to be the issue of the social implications of the Smart Cities agenda. If the Indian Smart City turns out to be little more than an ITC-driven version of the gated community, then the mission will have failed.

This means that public debate on urbanisation, including Smart Cities, is intense since it is closely intertwined with other hot topics such as land acquisition, political governance, the battle against corruption, the delivery and quality of public services and socio-economic conditions in general.

The issue of planning is often emphasised because a controllable city development implementation process is essential. There is a planning backlog in most Indian cities, because spatial planning is carried out on the basis of master plans devised 10-15 years ago. Since allocation of land for urban development is the main feature of the master plans, the issue of availability of resources such as materials, water, energy and mobility is often ignored. The debate points out that the master plan process is

in danger of becoming a vehicle for speculation in short-term financial gains, if not outright corruption. The frequent result is that large segments of the population will not benefit from the plans in place, thus allowing situations similar to those in New Delhi to arise. In that city it is estimated that one third of the population falls outside any city-authority governance. It is therefore argued that for Smart Cities to succeed, a robust planning tool must be in place.

Another issue of discussion is for whom are the Smart Cities intended? It is argued that Smart Cities are at risk of becoming "special enclaves" that will be both financially and physically inaccessible to the vast majority of the Indian population. If the Smart Cities turn out to be islands surrounded by a sea of poverty and poor services, the reaction to Smart Cities may be quite the opposite to that intended. Hence, the planning of Smart Cities needs to address issues far beyond physical planning and technological solutions. As a result, the logic is that it becomes necessary to consider the interaction of Smart Cities in an environment that is otherwise characterised by the absence of stable infrastructures and service networks.

Use of data

In 2012, the Government of India initiated an open-data portal: <https://data.gov.in/>. The Smart Cities programme will expand this open data approach since all Smart Cities will be tasked with the target of creating Open Data Platforms with regular updating. There is a debate about data protection and the handling of personalised data in relation to the concept. However, this is not a particularly prominent feature of the debate because focus is on the provision of reliable infrastructures and stable delivery of urban utilities.

Gujarat International Financial Tec-City - GIFT

In India, the creation of innovative cities will require reforms and innovation across sectors; and a number of equally important and relevant objectives need to be taken into consideration. Gujarat International Finance Tec-City Company Ltd., one of the most ambitious projects ever undertaken in Indian infrastructural space, is being designed as a hub for the global financial services industry.

The development of GIFT provides a significant opportunity to have a test-bed to drive reforms and innovation in various fields, including delivery systems, local government, physical planning, infrastructure development, environmental protection and so forth. Getting these foundation principles right is crucial for the planning and execution of development strategies.

One of the challenges for the GIFT-project to become a true model for the innovation of liveable urban spaces in India is to ensure that GIFT will also provide a model for the integration of low-cost housing and services for less privileged segments of the population. This means that the governance model of the city needs to include proper representation and safeguarding of the interests of those inhabitants who are not engaged in global finance but who are otherwise working in occupations/ services relating to urban life. As of now, it is not known how the local governance of GIFT will address this challenge since the construction of the city is in its early stages and will not be completed before 2021.



Photo: <http://giftgujarat.in/>

GIFT's Smart City's elements

GIFT's Smart City is evident in two major elements in particular, which are described in depth in the masterplan called **The Intelligent Urbanization** (see <http://www.giftgujarat.in/masterplan/green-gift.aspx>)

1. Efficient, Safe and Smart Buildings with

- Integrated **Surveillance System** for Safety & Security
- Efficient operation and management of **building services**
- Immediate Emergency Response for **Disaster/Crisis Management**
- **Interface and interaction between all services**
- **Remote vacant area/building monitoring and control**
- **Room-temperature control**

2. Green Buildings & Physical Environment

- **High-energy** evolving fusion of Nature and Technology, enhancing the zest for work & life
- **Reduced use/waste of energy** thus reduced energy bills
- **Sky Gardens/Roof-top gardens**
- **Non-conventional energy resources** such as solar heating of water and rain-water harvesting
- Planning and Design considerations according to **micro-climatology**

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