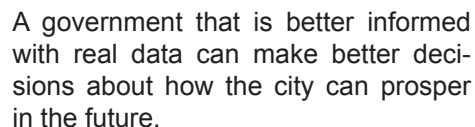


City design has remained essentially unchanged for the last 1000 years, but rising populations are forcing us to re-think the way our cities are designed. Currently more than 50% of the world's population lives in cities, and as populations rise there are greater challenges with respect to traffic control, reducing emissions, availability of resources and generally making the city a pleasant place to live and work.

There is increasing competition amongst cities to engage and attract new residents, businesses and visitors, and those that incorporate smart technology are more likely to stay ahead of the game. Previously cities built skyscrapers to impress; the taller the building the better. Future cities aim to impress by incorporating a network of technologies and becoming more carbon neutral. We live in an Information Age, and the development of communication systems has facilitated increased connectivity via the “Internet of Things” (IoT). The IoT interconnects smart devices such as mobile phones, computers and sensors, enabling the transfer of vast amounts of information, otherwise known as “Big Data”. Smart cities aim to use this data to get to know the city better, to spot trends and target weaknesses in the infrastructure and ultimately improve the city design.

ABI Research estimates that over 40 billion devices will be wirelessly connected to the IoT by 2020.<sup>1</sup>

“Smart City” is a general term for any city that uses advanced technology to address and improve different aspects of society, including (1) Planning and Management, (2) Infrastructure and (3) People, as shown in the image below.<sup>2</sup> The degree to which each aspect is addressed will depend of the profile of the individual city, e.g. location, social structure, availability of resources etc.



## EXAMPLES OF SMART CITIES

Examples of Smart Cities are already in place all over the world. *Rio de Janeiro, Brazil* opened an operations centre in 2010 which uses an impressive 80m wide wall to stream video feeds from 900 cameras around the city. Satellite maps feed in weather data and fifty operators from 30 different city agencies monitor the city in real-time. Data analytics software is used to predict how

traffic will flow, and where accidents or flooding are likely to occur. In the case of an emergency the operators can act quickly, diverting traffic and notifying the correct authorities. The media room is situated directly above the operations centre, facilitating the transfer of information. The operations centre enables an enhanced level of connectivity between the governing bodies and the residents of the city. The residents can

view the video cameras real-time using the internet, and notify the authorities of problems in the city by taking photos and sending them via their smart phones. *Barcelona, Spain* has embraced the concept of the IoT and installed free wifi across the city, allowing the citizens to be constantly connected even whilst travelling on the metro. Statistics indicate that 40% of the traffic in city centers is caused by cars trying to find parking spaces. In Barcelona they have implemented parking

sensors with an online app, so that the residents can view online the availability of parking spaces.

In November 2014 the city of *Copenhagen, Denmark* won the prestigious World Smart City Award, which is awarded annually at the Smart City Expo. The award was granted for the project “Copenhagen Connecting”, which aims to use big data from mobile phones, GPSs in buses and sensors in garbage bins and sewage systems to reduce traffic congestion, air pollution and carbon emissions. The city was previously ranked as the number one smart city in Europe in 2013. Copenhagen has one of the lowest carbon footprints per capita in the world. It also



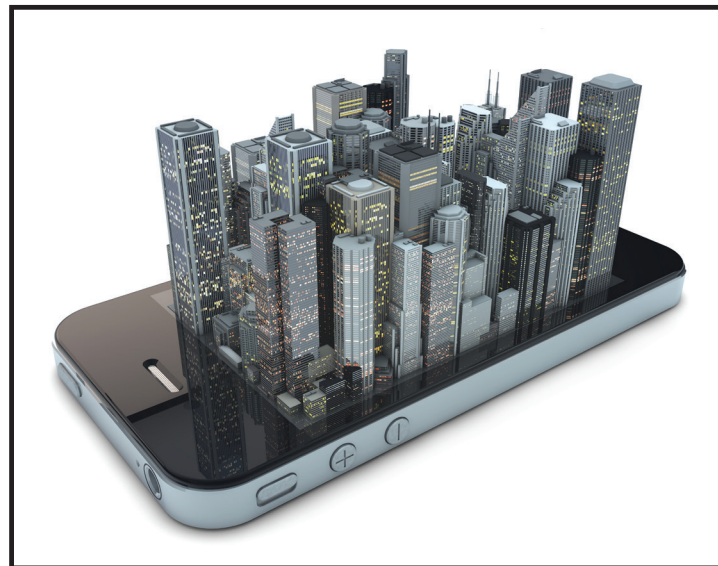
has an impressive number of resident cyclists- approximately 40% of all commutes are conducted by bike. The city continues to set ambitious targets for the future, aiming to be completely carbon neutral by 2025.

*New Taipei City (NTC), Taiwan* has been ranked as one of the top seven smart cities for 2015. NTC has connected more than 300 schools by putting tablets and computers into classrooms and has facilitated the installation of more than 10,000 Wi-Fi hotspots in convenience stores. The government has begun to implement a public and service cloud- called the G-Cloud. The public cloud aims to enhance internal administrative efficiency, whilst the service cloud aims to improve the interaction between the government and the citizens.

### MAJOR MARKET PLAYERS

Major IT companies around the world are addressing the potential of smart cities, focusing on the interconnection between cleantech and information technology. *General Electric, Siemens, IBM and Cisco*, as well as global consultancies such as *Accenture, Arup and WSP*, are addressing the challenge of how cities can use technology to optimize resource use. *GE's Ecomagination* brand provides technologies for renewable energy, water filtration and wastewater treatment, smart building initiatives, sensing and detecting equipment, traffic signaling and transportation monitoring and management systems. The company also runs a GE Cities of the Future program. GE is partnering with national and regional

ship with the Economist Intelligence Unit, Siemens also runs the Green City Index, which measures and ranks the environmental performance of cities from around the world. IBM is involved in pilot smart grid projects around the world, ranging from smart meter roll-out to country-wide integration. In 2010 it launched the Smarter Cities Challenge, which is IBM's largest philanthropic initiative, with contributions to date valued



at more than \$50 million. IBM has deployed 700 top experts to help 116 cities around the world. In 2015, the program was extended for a fifth year, with additional projects to be deployed through 2016.

Cisco runs the Smart+Connected Cities program using intelligent networking capabilities to weave together people, services, community assets and information. Cisco's connected city

governments to build new innovation centers while encouraging those areas to adopt smart grid incentives, such as in Markham, Ontario and Masdar in Abu Dhabi. Siemens has initiated the City of the Future program and is involved in a broad range of city pilots globally. In partner-

partners include Amsterdam, Bangalore, Barcelona, San Francisco, and the South Korean cities of Incheon and Busan.

### MARKET POTENTIAL

According to a corporate study conducted by Frost & Sullivan<sup>3</sup>, by 2025 around half of the world's smart cities will be in Europe and North America.

In India and China, we may see the creation of as many as 50 smart cities by 2025, some of them built entirely from scratch.

The "smart city" market envelopes a number of different smart markets, such as smart grids, smart transport and smart energy.

The global Smart Cities Market is predicted to grow from \$411.31 billion in 2014 to \$1,134.84 billion by 2019, at a Compound Annual Growth Rate (CAGR) of 22.5% during the forecast period 2014-2019.<sup>4</sup>

For the year 2016, the market research company ABI Research is projecting an

investment volume of over €30 billion for the installation of sensors in smart cities. This would be a fivefold increase compared to 2011. A study by the McKinsey Global Institute suggests the the worlds 600 fastest growing cities will account for 60% of the global economic growth between 2010 and 2025.

Written by Dr. Deborah Morecroft,  
Chief Technology Officer, NanoFab Tools S.L.  
Email: [debbie.morecroft@nanofabtools.com](mailto:debbie.morecroft@nanofabtools.com)  
[www.nanofabtools.com](http://www.nanofabtools.com)

### References:

- <sup>1</sup> <https://www.abiresearch.com/pages/what-is-internet-everything/>
- <sup>2</sup> [http://www.ibm.com/smarterplanet/us/en/smarter\\_cities/overview/](http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/)
- <sup>3</sup> [http://www.ibm.com/smarterplanet/global/files/us\\_en\\_us\\_cities\\_FS\\_IBM\\_Award\\_Report.pdf](http://www.ibm.com/smarterplanet/global/files/us_en_us_cities_FS_IBM_Award_Report.pdf)
- <sup>4</sup> <http://www.marketsandmarkets.com/Market-Reports/smart-cities-market-542.html>