

SMART CITIES

SPECIAL REPORT



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THE FUTURE OF SMART CITIES

While cities occupy around 2% of the world's surface, they accommodate 50% of its people and consume more than 75% of its energy, while producing almost 80% of its greenhouse effect.

As the imperative to manage resources grows, there is increased hope that the development of smart cities will reduce poverty, inequality and unemployment, while driving better, smarter resource management and efficiency.

This is according to a recent paper, *The Smart City Concept in the 21st Century* (Mircea Eremia, 2017), in which the authors believe that smart cities share common traits, namely that they use ICT to enhance the liveability of their cities, ensuring its workability and sustainability. Furthermore, a smart city monitors and integrates the condition of all its critical infrastructure, so it is able to better optimise its resources, plan preventative maintenance activities and monitor security, while maximising services to its citizens.

While there are many definitions put forward by a multitude of authorities, the main themes – resource management, efficiency, use of data and a strong focus on sustainability – are consistently mentioned. In trying to determine parameters for the definition and evaluation of a smart city, ISO standard 37129/2014 defines 17 key indicators, namely: economy, education, energy, environment, finance, fire and energy response, governance, health, recreation, safety, shelter, solid waste, telecommunications and innovation, transportation, urban planning, wastewater, water and sanitation.

“As ICT evolves, it will allow for further integration of all elements of the smart city through interconnected telecommunications networks.”

Information and communication technology (ICT) is an essential component in promoting a smart city as it is an enabler to smarter resource use and monitoring. As ICT evolves, it will allow for further integration of all elements of the smart city through interconnected telecommunications networks, integrated sensors, physical components and software tools.

This is particularly seen in the development of smart buildings which incorporate communication and control systems in order to optimise resource use, particularly heating and cooling.

Smart energy resources interconnect utilities and users through smart grid applications, optimising network operation. As the smart grid develops, it will further enhance continuous, real time monitoring of energy, water and natural gas by utilising smart meters and online monitoring information. Coupled with smart water management and distribution, efficient water usage and wastewater management can be firmly brought in to the digital era.

Because of the integration of systems across both vertical and horizontal infrastructure, smart cities can be referred to as 'systems of systems'. Mircea Eremia et al say that “while the IT&C infrastructure is the support level for management and control applications, the smart grid is the system that makes all the other systems function.”

As electricity is one of the most important elements of any city, its unavailability will directly impact on multiple other utility functions and city services. As a result, efficient development of energy networks and optimal usage of energy is critical to achieve both energy savings and energy efficiency.

Smart grids in smart cities encompass five key elements – promotion of clean energy sources, smart metering, efficient public lighting, integration of electric vehicles and active consumer involvement.

In the pages following, we examine the role of the utility as an enabler for the smart city, as well as how progressive technologies such as smart grid, smart metering and electric vehicles will shape the smart city of the future. ■

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HOW PROGRESSIVE TECHNOLOGY WILL SHAPE THE SMART CITIES OF THE FUTURE

In this article, we explore how technology, more specifically big data and IoT, is transforming the development of smart cities.



The growing population and pressure on existing urban areas creates a significant challenge as to how we build and operate cities and improve the quality of life for billions of people worldwide.

The engineering industry is now rapidly exploring the technological options available, such as data analytics and IoT, to meet the rising challenges in urban areas. Technology

is being viewed as a solution to improving city transport links, energy usage, waste and water management and a range of other services that are integrated with urban living.

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Big data and analytics

Smart cities consistently generate a significant amount of data which is now being collected and made available. If managed, measured and analysed accurately, big data can provide vital insights and financial value for urban areas. Urban stakeholders can utilise this data to enhance efficiency and develop innovative, new services that can overall improve the lives of the urban population. Cloud computing is a fine example of evolving technology that can leverage big data, capturing and analysing trends and patterns.

With technological improvements and reductions in overall costs, more resources are now accessible by city stakeholders. These services can allow urban areas to improve the overall efficiency of operations and services in the city. This includes the ability to improve the efficiency of waste management in Boston by converting to a demand-driven approach; to London utilising data and analytics to map particular neighbourhoods to clearly understand planning and resource allocation.

The Internet of Things

Smart cities and the Internet of Things (IoT) have been highlighted as a driving force in creating a new age for urban living and development. With a suggested range of benefits such as lower pollution levels, improved energy efficiency and an overall higher quality of life, a strong emphasis has been placed on new technology, and how it can be utilised in the progression of smart cities.

Updating existing urban infrastructure

To utilise the benefits of IoT and new technology in smart city development, changes will need to happen to the current urban infrastructure. For example, finding parking in an urban area is a common challenge for many individuals. According to Information Age, the average driver in the UK spends nearly 60 hours a year trying to find a parking space! IoT technology can really improve this problem by clearly identifying available parking space to the driver and reducing time spent.

Cyber systems and the IoT are generally regarded as essential for the continued growth of smart cities. The IoT is rapidly

changing the way traditional city services (such as energy and water) are monitored. Certain infrastructure which was traditionally monitored is now being connected using standard protocols. This information is then made available through a range of web technologies. Reduced 'hook up' costs are also expanding sensing through city facilities. The energy industry is a fine example of sensing with many city buildings being 'hooked up' via smart energy meters.

The costs and availability of IoT technology today is allowing more and more companies to action infrastructure and utilise devices that most citizens tend to carry regularly. Citizens are now able to be involved in sensing by utilising their devices (smartphones) to track urban factors such as air pollution or noise levels. The IoT is advancing a massive transformation in how we can sense and control the world we live in.

The rise of new technology has the opportunity to effectively contribute to the growth of smart cities. Smart cities need to ensure any infrastructure systems can be connected and provide aggregate efficiencies and support new services. New technology can really help urban areas tackle the complex environmental, economic, and social challenges by allowing efficient and effective strategic planning. Big data and new technology can improve the overall efficiency of urban infrastructure, the supporting networks and the lives of the urban communities. This is just the beginning, and the potential benefits could go further. ■

ABOUT THE AUTHOR



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INDIA'S SMART CITY MISSION

The Government of India and the Ministry of Urban Development (MoUD) launched the "Smart City Mission" in 2015.

The cities propose development across one of three strategic imperatives: city improvement (retrofitting), city renewal (redevelopment) and city extension (greenfield development). In order to create a sense of inclusiveness for residents, each of the proposals will require at least one "city-wide smart solution."

In January 2016, the first 20 cities were announced, and many of these are well under way to implementing the projects that were originally identified in their smart city proposals.

Cities such as Bhubaneswar, Pune, Surat, and Ahmedabad have promising growth potential in the next five years and also have high investment opportunities in the smart city proposals.

Pune Smart City

As the ninth most populated city in India, and the second largest in the state of Maharashtra, Pune has made great efforts in the development of human capital within the city. There are 811 colleges which have driven an IT revolution within the city, many top IT companies have their presence in Pune, and it is the second largest software hub in India.

The strategic imperatives for the development of Pune Smart City include:

Fixing core urban infrastructure and making it 'future proof'

This includes upgrading infrastructure supporting ICT solutions for roads, the metro, urban mobility and water. In addition, the city needs to address the challenge of housing within the city confines.

Mobility challenges form a core part of this strategy and planned improvements include increasing the use of public transportation to 50% by 2030, in addition to increased transport options. Supporting this are ICT solutions for adaptive traffic control and a complete redesign of streets, junctions and footpaths; the development of two ring roads; and increasing trip sharing to 40%.

The provision of equitable water provision is one of the key goals for the city and will comprise reducing leakage and non-revenue

water by 15% and increasing reservoir storage; full sewerage coverage; treating 100% of all waste water; and the promotion of grey-water use by industry.

Upgrades will also be done to critical infrastructure such as energy, and plans are for a smart grid and smart metering to be functional city wide. New buildings will have to meet energy efficiency requirements and the use of solar energy is proposed to grow to at least 20%. It is further anticipated that public lighting could reduce consumption by 5% with the implementation of smart systems.

Multiple sources of funding will need to be accessed in order to fulfil the city mission. This includes government funding, own funding, debt and public-private funding. The Pune Municipal Corporation has additionally created the first separate, ring-fenced infrastructure fund of its kind in India. Given the city's good credit rating (Fitch has rated the city AA), it is able to borrow at attractive rates.

Make Pune the most liveable city in India

Upgrading of neighbourhoods will help make Pune the most liveable city in India. Transformation of neighbourhoods will happen across social infrastructure such as schools and healthcare, across urban living space and liveability parameters such as pollution control, resource productivity and sustainability in order to provide a holistic approach to urban living.

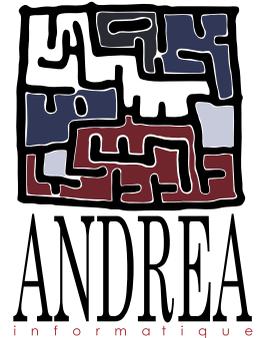
This includes a drive to include more open spaces in urban planning, including the development of parks. Waste disposal and segregation plays an important part in the 'beautification' of the city, with the goal being to make all neighbourhoods 'zero garbage'.

Through extensive civil engagement, the city was able to create two word clouds which represented citizen vision and challenges. The vision was clear – clean, beautiful and green. Challenges as determined by the citizens were transport, water and core infrastructure issues – many of which were already part of the Pune development strategy.

Developments have not been without their challenges and criticisms, but with projects under way across a multitude of cities, Prime Minister Modi's vision to improve the living conditions of the population is bearing fruit, with 99 proposals having been approved, which will ultimately impact on more than 100 million people. ■■

Trying to design a reliable and cost efficient meter?

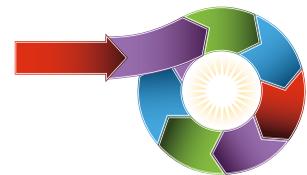
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UTILITIES CENTRAL TO SMART CITY DEVELOPMENT PLANS

Smart integration of infrastructure makes cities more liveable, sustainable and resilient. This is the message from a series of reports written by Black & Veatch as part of their Strategic Directions series of reports.

Without supporting infrastructure, cities of tomorrow will not operate effectively, and there will be little or no growth or improvement to the quality of lives of the city residents. While there may be a growing awareness that technology can reshape service delivery, and enable better management of energy, connectivity, consumption and an increasingly finite supply of water, we still have a long way to go.

Management consultants ScottMadden believe that while “there are many technologies that can be considered elements of a potential smart city plan, energy – given its technological maturity, pervasive application, and existing infrastructure – is often a good point of focus for city planners.

“Energy utilities possess a physical network with a ubiquitous footprint underpinned by a data control network. Most smart city visions call for one or both of these network capabilities. It may be less efficient for the city to build a data network from scratch than to piggyback on the utility data network already in place. Especially since those networks are being

funded by utility customer-citizens and in many cases are being digitally upgraded as utilities build out advanced metering infrastructure.”ⁱ

Jim Anderson and Mark Leinmiller concur, writing that “urban planners should be operating an infrastructure first strategy. To support a growing and aging population, the framework of the city – the electric grid, water management system, commercial buildings, traffic management systems, etc. – becomes most important. And intelligent energy use is one of the central components to achieving all of a smart city’s goals.”ⁱⁱ

As Stephen DeAngelis of Enterra says in his blog post in 2015: “In order to make an electrical grid smart, you need data. Smart grids start with data and its analysis.”

ScottMadden believes that the delivery of smart cities will be dependent on multiple roleplayers and anticipates that the following scenario may well play out. Municipalities or city administrations will bring to the table their leadership and goal setting abilities, while utilities bring their deep knowledge of customers and networks. Vendors will continue to be providers of technology solutions, forming strategic partnerships while the citizens will bring engagement and participation.

“Urban planners should be operating an infrastructure first strategy. To support a growing and aging population, the framework of the city – the electric grid, water management system, ... – becomes most important.”



Figure 1: Smart city phased approach for utilities

Source: ScottMadden

“Advanced analytics will enable utilities to determine hidden energy usage patterns.”

Data can be leveraged in many ways in order to optimise power delivery and with smart meters, utilities have access to so much more actionable data. As a result, companies operating in the energy industry should be able to offer more competitive solutions to the smart cities market.

Anderson and Leinmiller add: “Companies in the energy industry are in the unique position of offering more complete solutions for the smart cities market.” Utility companies are in a position, therefore, to offer new service packages to customers.

The opportunity for utilities lies in establishing their role as partners and leaders. Many are already focused on building out their networks, and the opportunity here is to leverage existing networks, engage with stakeholders and be seen as thought leaders. From there, the next step is to utilise existing networks outside of the traditional utility sphere.

Advanced analytics will enable utilities to determine hidden energy usage patterns – or determine if a user is likely to be stealing or misusing their energy. They are able to optimise heating and cooling settings or seamlessly integrate electric vehicles into the grid.

Juniper Research has found that the development of smart grids linked to smart cities will result in citizens saving \$14 billion per annum in energy bills by 2022.

This is up from the \$3.4 billion saving estimated for 2017, resulting from smart meter rollouts, energy-saving policies

and sensing technology to improve grid reliability and efficiency.

As part of the new studyⁱⁱⁱ Juniper analysed and ranked global cities to assess their performance and approach towards energy consumption and delivery, ranking Seoul, San Francisco, New York, Portland and Barcelona in the top five.

“Seoul’s large-scale deployment of electric vehicle charging infrastructure, smart street lighting and smart meter rollouts will undoubtedly accelerate the development of smart grid infrastructure to manage these elements,” remarked research author Steffen Sorrell.

Juniper found that the high cost of carbon capture and storage technology was making fossil fuel investment uneconomical. With the projected cost of renewable energy sources such as wind and solar falling close to \$60 per MWh in 2022, it predicted that the inevitable investment would force accelerated deployment of smart grid solutions to reliably scale renewable energy.

Furthermore, the research argued that the business case for distributed renewable generation would be strengthened by the application of blockchain. Here, dramatic efficiencies along the value chain could be achieved by simplifying a certification system currently susceptible to accounting errors and increased costs.

As utilities globally have continued to ponder their future, it may be that the development of smart cities is one of the alternative futures a utility could be considering. By being considered an integral part of the set-up of the future city, the utility’s role will evolve to being one of the central spokes in the wheel that makes up the city’s administration and development. ■

ⁱ *The Smart City Opportunity for Utilities*, ScottMadden, May 2017

ⁱⁱ “Why smart grid and smart water are essential to a smart city,” 19 February 2014

ⁱⁱⁱ *Smart Cities: Strategies & Forecasts in Energy, Transport & Lighting 2017-2022*. Juniper Research

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