

The Evolution of Smart Cities

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Abstract- *As the worldwide population is growing continuously at an unprecedented pace, a large number of individuals are moving to urban areas each and every day. Indeed novices can foresee that the urban population be doubled within a brief period of time. The world is becoming more urbanized. To handle such urbanization, it is the need of the hour to make our cities even smarter. Smart cities find new ways to manage complexity, increase efficiency and reduce expenses and provide a high quality life. This need, leads to the development of 100 smart cities as a part of “Modi’s acche din vision” from the outset. This present paper aims to shed light on the often elusive definition of the concept of the “smart city”.*

Keywords- *Smart Cities, infrasturcture, urban development, urbanization, city planning.*

I. INTRODUCTION

India’s Prime Minister ‘Narendra Modi’ has often talked of developing smart cities. Even in his speech, he made a reference of his dream project of developing 100 smart cities. The main question is what smart cities are and what their significance in respect to Indian scenarios is. A smart city may be defined as a developed urban area that creates sustainable economic development and high quality of life by excelling in multiple key areas like economy, environment, mobility, people and government. Excelling in these areas can be done through strong human capital, social capital and/or ICT infrastructure [1]. A 'smart city' is an urban area that is highly advanced in terms of overall infrastructure, communications and business sector. Vishal Malik, a property brokerage and director of

Coldwell Banker India said “Integral to a smart city is information technology, where a network of sensors, cameras, wireless devices and data centers form the key infrastructure for providing services”.

A ‘smart city’, ‘intelligent city’ or ‘digital city’ can be defined as a developed urban area that makes practical financial improvement and high caliber of life by exceeding expectations in numerous key territories like economy, portability, environment, individuals, living, and government [2]. Smart Cities bring technology, society and government together to enable smart people, smart buildings, smart transportation, smart networks, smart communications, smart energy, environmental awareness and smart economy. In a nut shell, a smart city includes smart living.

A smart city uses digital technologies to enhance performance and to reduce cost and consumption of various resources [3]. Key 'smart' sectors include transport, energy, health care, water and waste. The different technologies associated with urbanisation are smart building controls, wind turbines, intelligent lighting, facial recognition, solar panels, low power semiconductors, wireless charging for automobiles, LED lighting, crowd sourcing techniques, traffic control, medical alerts, etc.

“Smart cities should be regarded as systems of people interacting with and using flows of energy, materials, and services and financing to catalyse sustainable economic development, resilience, and high quality of life [4]. These

flows and interactions became smart through making strategic use of information and communication infrastructure and services in a process of transparent urban planning and management that is responsive to the social and economic needs of society”.

The world urbanisation is growing continuously and it is expected that the total population will get doubled by 2050. Hence there exists an increased demand for smart, intelligent and sustainable environment that will reduce the environmental impact and also offer citizens a high quality life [5].

The idea of smart cities originated when the whole world was facing economic crises. In 2008, IBM began work on this concept as part of its Smarter Planet initiative. By the beginning of 2009, the idea had enraptured the imagination of many nations across the world. Countries like South Korea, UAE and China began to invest heavily into their research and formation [6]. Today, a number of excellent precedents exist that India can emulate, such as those in Vienna, Aarhus, Amsterdam, Cairo, Lyon, Malaga, Malta, the Songdo International Business District near Seoul, Verona etc. The up and coming era of urban communities will need to fulfill purchasers' qualities, and convey comfort and thriving while likewise reacting to changes in the worldwide environment and urban environment.

II. HOW SMART CITIES CAN TRANSFORM THE LIVES OF PEOPLE

In a smart city, infrastructure such as water, sanitation, energy, transport, public safety, education and health care are integrated and managed through technology for efficient governance and delivery. Smart Cities transform the lives of the people by bringing technology, society and government together. It enables smart networks, smart buildings, smart transportation, environmental awareness, smart energy and smart people.

1. Smart grids or intelligent utility networks

Smart Grids alleviate problems such as reducing faults, improving responsiveness of utility companies to handle demand variations, increasing efficiencies by reducing transmission & distribution losses, and managing costs better. They allow customers to participate in the energy value chain, by enabling more intelligence throughout the grid [7].

Smart Grid solutions are built on instrumentation such as smart meters, digital sensors, advanced communication networks and sophisticated analytics. By enabling intelligent flow of information, Smart Grids optimize regulation, generation, supply and consumption of electricity. Next generation smart grid would enable the Smart City to grow its power requirements to meet its growing energy needs. And as multiple generators from diverse energy sources (hydroelectric, fossil fuel, solar, wind, etc.) feed variable demand through variable generators, the grid would be designed to provide for minimizing the fault-currents through the use of next generation fault-current limiters and switch-yard designs. Moreover, the potential of solar rooftop would be maximized by deploying guidelines on roof-heights and shade-limiting, individual rooftop solar harvesting opportunities.

2. Smart buildings and urban planning solutions

Smart Buildings are an essential and defining element of Smart Cities. A Smart Building is designed to optimize usage of energy and water, and to minimize environment impact. Automation systems in such buildings provide visibility and control of their energy usage, safety and security. In addition, these buildings interact intelligently with a Smart City infrastructure such as the Smart Grid, water and waste management systems, Telecom infrastructure and other ICT enhanced services.

The enablers of the economy of the 21st century need to strongly consider buildings

built to efficiency standards that greatly reduce the required renewable energy load required to drive it [8]. Today energy demand reduction technology is far cheaper than renewable energy. By managing both you can optimize the installed cost of renewable energy by reducing demand through energy efficient technologies. Some of the building blocks of smart building and urban planning solutions include real estate management, capital projects management, space management, facility maintenance, and energy management.

3. Intelligent transit

Traffic congestion and gridlocks affect safety and the environment. Intelligent transportation solutions are designed with the purpose of reducing traffic congestion, improving incident response, optimizing traffic flow and proactively manage traffic conditions. They achieve this through live traffic monitoring, analysis and prediction capabilities, by leveraging data from disparate sources, such as IP cameras, radar and under-road loop detectors as well as systems based on Bluetooth or mobile phone technology on a common city network infrastructure [9]. Additionally, intelligent investment in transportation infrastructure would support more sustainable and safe investment. From road bed insulation to prevent cracking from weather extremes to water-soluble (and less toxic) paints for road safety markings – technology can ensure safer and longer-lasting infrastructure.

4. Smart Parking

Parking can be a challenging issue, especially in urban areas where 30 percent of all traffic congestion is caused by drivers circling to find space. Adding to that the amount of time wasted and the limited data available to guide motorists' decision making lowers the quality of life [10]. Cities are also losing out through the damaging environmental effects, lost revenue due to inadequate meter enforcement and no-parking, standing, and loading zone violations. Income for shops and local businesses is also heavily affected by the availability of parking. Smart parking

approach to city parking takes full advantage of the common network infrastructure. The technology combines IP cameras, sensors, smartphone apps, and the citywide network infrastructure to provide parking availability to citizens in real time. The system also provides greater visibility into parking analytics, such as usage and vacancy periods, so cities can make better informed decisions and long-term plans. The end result is less traffic congestion and a more effective partnership between cities, citizens, local businesses, and parking enforcement agencies.

5. Intelligent water management

Water can often be one of the city's most stressed resources, where access to clean water affects economic activity, development and business. Challenges include better management of supply and distribution, preventing waste, and dealing with aging infrastructure.

Intelligent water management solutions use instrumentation (e.g. metering systems) and analytics to better manage demand and supply. For example, they can anticipate potential delivery disruption, better forecast long-term demand, and coordinate resources to protect water supply [11].

Furthermore, intelligent water management solutions provide insights into the utility's infrastructure, assets and operations – detecting patterns and anomalies and then acting on them. Such capabilities include pressure and leak management, flood management, sewer overflow mitigation, quality management, and work scheduling.

Most importantly, smart water management should focus on ensuring high quality resources for public consumption leveraging the appropriate technology (UV filtration, reverse osmosis membranes etc.) to meet the quality needs necessary to build healthy communities.

Additionally, intelligent water management should incorporate public-private sector cooperation on deploying technologies to support resource-smart manufacturing. Water is a necessary element of manufacturing – but the myriad of technologies and processes can encourage more efficient utilization from

water management to recycling, to zero-waste plant designs. The Government of India should incentivize innovative technology uses for manufacturing investment and for appropriate leveraging of local water resources.

6. Smart lighting

According to several surveys, Street lighting equals 40 percent of the electricity bill of municipalities. Maintenance of streetlights is an operational issue given large numbers and geographical distribution.

According to the data, lighting accounts for 19 percent of all electricity consumed. One-third of the world's roads are still lit by technology dating back to the 1960s. The installation of new street lighting solutions can save up to US\$13.1 billion in energy per year [12].

A leading lighting company estimates that a complete switch to LED technology can generate savings of about US\$179 billion - an enormous sum equivalent to the elimination of 640 medium-sized power stations globally.

Furthermore, an independent, global trial of LED technology found that LEDs can generate energy savings of 50 to 70 percent - with savings reaching 80 percent when LED lighting is coupled with smart controls. LED lighting provides a greater sense of safety and improved visibility.

A smart lighting approach helps cities manage street lighting to reduce energy and maintenance costs through a common network infrastructure. The outcome is reduction in energy consumption on street lighting and optimization of management/maintenance process of large-scale lighting deployments. Building insulation, alternative energy (solar for homes), and upgraded transmissions lines can ensure that the energy available is maximized for all available uses.

7. Smart People

Smart Cities support the needs of each citizen through social programs, healthcare and education.

Social programs and healthcare

Smart Cities focus on optimizing outcomes of social programs for citizens. Social Program

Management solutions are business process management solutions, which manage the end-to-end lifecycle of such programs from intake to outcome. Additionally they have capabilities for evidence and eligibility management [13].

Specializations of these solutions may include child welfare or medical assistance programs. Such specializations may model various government programs such as subsidized education, medical assistance and insurance models, and help automate eligibility and entitlement determination.

Education

Smart Cities must have explicit focus on quality education, since schools and higher learning institutions define a society's long term health and prosperity, educating the workers and leaders of tomorrow.

Smart education solutions are designed to optimize student performance, teacher training, helping low performing schools and school administration.

Smart schools leverage automation and technology to capture critical data, such as attendance, grades and enrolment in activities [14]. They also use technology to deliver digital course content through smart, interactive classrooms. Further, they use student-centric analytics solutions to get real-time perspective of student performance, and plan interventions to improve performance and employability.

Smart schools allow content sharing, teacher training, sharing of scarce resources, etc. This can also be extended to parents. They can track academic grades and scores, attendance and comparative data online.

Additionally, Smart City programs should incorporate education and engagement of high-skilled professionals creating a network of research institutions which would provide a cadre of decision makers and intellectuals that influence the societal and governmental adoption of such new concepts.

III. CHALLENGES

The concept is not without challenges, especially in India. The success of a smart city depends on residents, entrepreneurs and

visitors becoming actively involved in energy saving and implementation of new technologies [15]. Also it takes around 20 to 30 years to build a smart city. There are many ways to make residential, commercial and public spaces sustainable by ways of technology, but a high percentage of the total energy use is still in the hands of end users and their behaviour.

Though the concept of smart cities has significant effect on economic growth, it also gives rise to many challenges which can be summarized as:

- Rising levels of pollution
- Potential cultural clashes
- Population explosion
- Increased crime rates
- High cost of living

Failure of the regional planning led to the rise of urbanization. It is an opportunity for achieving faster growth. Though smart cities have a high cost of living, but it has been overcome by its numerous benefits. A smart city should be able to respond faster to the above challenges. The challenges like economic restructuring, climate change, online retail, entertainment, ageing populations, etc have increased the interest in the smart cities.

IV. INDIAN INITIATIVES

India has various proposed smart cities which include Kochi in Kerala, Ahmedabad in Gujarat, Aurangabad in Maharashtra, Manesar in Delhi NCR, Khushkera in Rajasthan, Krishnapatnam in Andhra Pradesh, Ponneri in Tamil Nadu and Tumkur in Karnataka [16].

1. Ahmedabad

Ahmedabad, in Gujarat, may become the first smart city in India in Narendra Modi's dream project. It may also be called as Gujarat International Financial Tec City (GIFT). It is 18 kms from the Ahmedabad airport. This

project will cost around Rs. 70,000 crore. It will be developed over 886 acres. It is being under construction since 2011. It will provide high quality infrastructure. It will feature remote management of utilities from a single command centre, use of data analytics and real-time monitoring of services. It will also provide an international education zone, a special economic zone, integrated townships, an entertainment zone, an international techno park, shopping malls, software technology parks, stock exchanges and service units. It also promises for atleast 10 lakh jobs [17]. GIFT, currently under construction, has also had a considerable impact on prices in and around the area. Prices of apartments there are Rs 3,000-5,000 per sq ft. Certain localities in Ahmedabad such as Valad, Urjanagar and Chandkheda have seen good price appreciation (as much as 30-40% annually). Going forward, one may expect 10-15% annual price rise, says Jain.

2. Kochi

Another smart city of India is Kochi which is situated in Kerala. This smart city will be developed over 100 hectares. It has a special economic zone that seeks to replicate Dubai's smart city project. Kochi smart city has put life in the region's dull real estate market.

3. Naya Raipur

Naya Raipur will also be developed as a smart city. Being environment friendly, smart cities use sustainable materials for building facilities and also to reduce energy consumption.

4. Delhi

Wave Infratech is constructing a smart city near Delhi. It will be developed over 4500 acre area. It will be managed by a central command centre. It will feature automated traffic signals, fiber optic connectivity, custom-made water and electricity meters to generate bills, garbage control, CCTV cameras servicing day and night. It will also have buses that will send messages to inform their arrival. It is expected to have seven new smart cities in India in the next decades. These seven smart cities will be developed along the proposed Delhi-Mumbai

Industrial Corridor (DMIC) some which would overlap with the Amritsar-Kolkata plan. The Dholera urban area is part of DMIC. In Wave City, prices have risen from Rs 7,436 per sq ft in June 2012 to Rs 8,102 per sq ft in June 2014, a rise of 9%.

5. Palava

IBM is working on 2,500 smart city projects globally. According to IBM, a smart city uses technology to transform its core systems. Outside Mumbai, the Lodha group has given IBM a contract to build all data systems in their Palava city project. In palava city, the rise has been from Rs. 2,643 per sq ft in June 2010 to Rs. 6,032 in June 2014, an appreciation of 128% [18].

6. Pune

The Amanora township in Pune is another such project. It will be developed on 400 acre. It seeks to integrate e-governance and security by having a dedicated internal portal and a multi-use smart card for identification, access and cashless payments. It will also include the person's medical records for emergencies. Smart cities can also be a good option for property investors. The prices of the property are increasing due to the development of smart cities. It can be seen from the following results of the Amanora Township in Pune. Kakkanad witnessed big land deals and prices shot up considerably. The region has seen steady price appreciation over the past few years. This is in contrast to other areas in the city where there has been a price correction. After a dull period in 2013, demand from the IT/ITeS sector is picking up, and one can expect 30-40% price appreciation over the next three years," says Jain.

7. 100 More cities

According to the budget speech presented by Finance minister Arun Jaitley, the Bharatiya Janta Party (BJP) had promised to build 100 hi-tech cities. He allocated Rs. 7,060 crore for the Modi's dream project which is a little over Rs. 70 crore per city. It takes 2-3 decades to build a new city. He also claimed that "unless new cities are developed to accommodate the

burgeoning number of people, the existing cities would soon become unlivable. Officially, the budget only pointed out three cities in the Chennai-Bengaluru Industrial Corridor: Ponneri in Tamil Nadu, Krishnapatnam in Andhra Pradesh and Tumkur in Karnataka. "There are some well planned cities that can be developed into smart cities. These are Chandigarh, Jamshedpur, Noida, Navi Mumbai, parts of the Greater Bangalore region, Mahindra World City in New Chennai, Lavasa (Lavasa Group) and Aamby Valley (Sahara Group) near Pune," says Anshuman Magazine, CMD, CBRE South Asia Pvt. Ltd.

V. CONCLUSION

The term smart city encompasses a vision of an urban space which is ecologically friendly, technologically integrated and meticulously planned with the use of information technology to enhance efficiency. According to Smart Cities Council, Smart cities are those that leverage data gathered from smart sensors through a smart grid to create a city that is livable, workable and sustainable. All the data that is collected from sensors like electricity, gas, water, traffic and other government analytics is carefully compiled and integrated into a smart grid and then fed into computers that can focus on making the city as efficient as possible. As demonstrated worldwide, Smart Cities require a holistic approach targeting all three pillars of a smart city namely Infrastructure, Operations and People. For India, smart cities are the need of the hour to achieve significant progress and create a thought leadership position in the global economy.

REFERENCES

1. Schweiker, Marit. "Aims and Goals of Smart City Management - Putting Quality of Citizens' Lives First." Council of European Municipalities and Regions, 5 Oct. 2010. http://ec.europa.eu/regional_policy/conferences/od2010/file-upload/2010/docs/39-05A34-

- Presentation_OD_Smart_Cities_CEMR.pdf .
2. Lombardi, Patrizia. "New Challenges in the Evaluation of Smart Cities." *Network Industries Quarterly*, Vol. 13, 2011. <http://newsletter.epfl.ch/mir/index.php?module=epflfiles&func=getFile&fid=241&inline=1>
 3. "Smart City." *Wikipedia.com* http://en.wikipedia.org/wiki/Smart_city
 4. Munier, Nolberto. "Handbook on Urban Sustainability." Springer, 2007. <http://www.springer.com/environment/environmental%2Bmanagement/book/978-1-4020-5350-4>
 5. Cohen, Boyd. "The Top 10 Smart Cities On The Planet." *Fast Company*, 11 Jan. 2011. <http://www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet> .
 6. Zhao, Jingzhu. "Towards Sustainable Cities in China." *SpringerBriefs in Environmental Science*. Springer, 2011. Page 2. <http://link.springer.com/book/10.1007%2F978-1-4419-8243-8>
 7. Hirst, Paula, Et Al. "JOINT EUROPEAN SUPPORT FOR SUSTAINABLE INVESTMENT IN CITY AREAS." European Investment Bank, 11 Dec. 2012. http://ec.europa.eu/regional_policy/the_funds/instruments/doc/jessica/jessica_horizontal_study_smart_and_sustainable_cities_en.pdf .
 8. Kehoe, Michael, Et Al. "Smarter Cities Series: A Foundation for Understanding IBM Smarter Cities." IBM - Red Books, 6 Dec. 2011. Page 3. <http://www.redbooks.ibm.com/redpapers/pdfs/redp4733.pdf> .
 9. Chourabi, Hafedh, Taewoo Nam, Shawn Walker, Ramon J. Gil-Gracia, Sehl Mellouli, Karine Nahon, Theresa A. Prado, and Hans Jochen Scholl. "Understanding Smart Cities: An Integrative Framework." Hawaii International Conference on System Sciences, 2012. Page 2290. http://www.ctg.albany.edu/publications/journals/hicss_2012_smartcities/hicss_2012_smartcities.pdf .
 10. González, Juan Andrés Alonso, and Andrea Rossi. "New Trends for Smart Cities." *Competitiveness and Innovation Framework Programme*, 2011. <http://opencities.net/sites/opencities.net/files/content-files/repository/D2.2.21%20New%20trends%20for%20Smart%20Cities.pdf> .
 11. Ott, Marc. "Tools for Sustainable Cities." HBR Blog Network, 20 Apr. 2011. <http://blogs.hbr.org/2011/04/the-sustainable-places-analyti/> .
 12. R.E., Hall, Bowerman B, Braverman J, Taylor J, Todosow H, and Von Wimmersperg, U. "The Vision of a Smart City." *SciTech Connect: U.S. Department of Energy*. Office of Scientific and Technical Information (OSTI), 28 Sept. 2009. <http://www.osti.gov/scitech/servlets/purl/773961>.
 13. Azkuna, Inaki. "International Study on the Situation of ICT, Innovation and Knowledge in Cities." City of Bilbao, 2012. Page 21. http://issuu.com/uclgcglu/docs/smartcities_study_en .
 14. Meijer, Albert, and Manuel Pedro Rodríguez Bolívar. "Governing the Smart City: Scaling-Up the Search for Socio-Techno Synergy." T EGPA 2013 (Edinburgh, September) Permanent Study Group on E-Government, 2013. https://www.scss.tcd.ie/disciplines/information_systems/egpa/docs/2013/BolivarMeijer.pdf
 15. IBM. "IBM's Smarter Cities Challenge." IBM Corporation, July 2013. http://smartercitieschallenge.org/scc/executive_reports/SCC-Copenhagen-Report.pdf .
 16. Batty, Michael, Kay Axhausen, , Giannotti Fosca, Alexei Pozdnoukhov, Armando Bazzani, Monica Wachowicz, Georgios

- Ouzounis, and Yuval Portugali . "CASA Working Paper 188 - Smart Cities of the Future." The Bartlett Centre for Advanced Spatial Analysis - UCL, 05 Oct. 2012. <http://www.bartlett.ucl.ac.uk/casa/publications/working-paper-188> .
17. Alcatel Lucent. "Understanding the Market Opportunity in the Cities of Tomorrow." Alcatel Lucent, Feb. 2011. http://www2.alcatel-lucent.com/knowledge-center/admin/mci-files-1a2c3f/ma/Smart_Cities_Market_opportunity_MarketAnalysis.pdf .
18. Renu Yadav, "Stay Smart", October 2014. <http://businesstoday.intoday.in/story/smart-cities-in-india-as-property-investment-destinations/1/210791.html>