

Holistic Infrastructure for Endeavor and Envision Smart City Challenge

Megha Jain

L.R.(P.G)College, Sahibabad
E-mail: megha7060@yahoo.com

Abstract—*Cities are like living organisms whose systems function synergistically. Greater access of the poor to education and health services, water and sanitation, road network and electricity is needed to bring equitable development and social empowerment. That's why a holistic approach to making cities smarter is required. Infrastructure investment is an important driving force to achieve rapid and sustained economic growth. Its installations do not produce goods and services directly but provide inputs for all other socio-economic activities.*

Cities are facing unprecedented challenges. The pace of urbanization is increasing exponentially. Every day, urban areas grow by almost 150000 people, either due to migration or births. Between 2011 and 2050, the world's urban population is projected to rise by 72 % (i.e. from 3.6 billion to 6.3 billion) and the population share in urban areas from 52 % in 2011 to 67% in 2050. India is no exception in this regard. To promote a thriving culture, cities must achieve economic, social, and environmental sustainability. In the holistic approach to the Smart Cities Mission, the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, and attracting people and investments to the City, setting in motion a virtuous cycle of growth and development and can make smart in the long run. Essentially, it's Institutional Infrastructure (including Governance), Physical Infrastructure and Social Infrastructure and IT infrastructure constitute the four pillars on which a city rests. This paper defines the characteristics of future city and analyses the integration of infrastructures.

Keywords:—*Institutional Infrastructure, Physical Infrastructure, Social Infrastructure, IT Infrastructure, Smart Cities Mission.*

1. INTRODUCTION

It is pathetic considering we have completed 67 years post independence and achieved little on the infrastructure front. The world is experiencing a period of extreme urbanization. As India's population continues to grow, more citizens will move to cities. Experts predict that about 25-30 people will migrate every minute to major Indian cities from rural areas in search of better livelihood and better lifestyles. It is estimated that by the year 2050, the number of people living in Indian cities will touch 843 million. To accommodate this massive urbanization, India needs to and smarter ways to manage complexities, reduce expenses, increase efficiency and improve the quality of life. Upgrading existing cities and creating new ones are prerequisites for economic progress and

they must take place in an organized manner. Looking ahead, the successful integration of automation and control systems, smart devices and data analytics across physical infrastructure can offer exciting opportunities for businesses, communities and governments. Next-generation Smart Integrated Infrastructure (SII) offers new prospects for effectively managing the myriad of power, water and telecom networks that impact people each day.

Global sustainability depends increasingly on the way our cities develop. Smart Cities focus on their most pressing needs and on the greatest opportunities to improve lives. They tap a range of approaches – digital and information technologies, urban planning best practices, public-private partnerships, and policy change – to make a difference. They always put people first. *The need for sustainable infrastructure development can hardly be overstated at this critical juncture when more and more people enter the workforce every year in search of jobs that presents us with a 'demographic dividend'. "It is important for a smart city to offer decent living options to every resident. Smart City should provide a very high quality of life - comparable with any developed European city, deliver all services to citizens and businesses in an integrated and resource-efficient manner while enabling innovative collaborations to improve quality of life," One of the key challenges in front of the present government is rapidly developing India's infrastructure. This is because infrastructure is not only critical for the movement of labor and capital across the length and breadth of the country but also is instrumental in basic development as well as in increasing the speed of doing business and provides sustainable development. Improving efficiency of city services and facilitating a more sustainable development of cities are the main drivers of the smart city concept.*

The first imperative is that a city needs to be sustainable in order to be smart. Improving efficiency of city services and facilitating a more sustainable development of cities are the main drivers of the smart city concept. This will mean that the interventions under the Smart Cities Mission need to align their goals, objectives and processes to the overarching principle of sustainability. The second imperative that emerges

is the importance of imbibing the characteristics of good governance for achieving sustainability. For example, transparency, accountability, participation and consensus-building are some of the key characteristics of good governance, which form the foundation for ensuring equity. The third imperative is to understand the role and use of technology in urban development. There needs to be a departure in the way technology is being portrayed as the panacea of all urban ills. It is in fact an important enabler, which can yield the desired results only when applied in a context-specific manner. Collective vision, supportive policy instruments and domestic stability are equally important in achieving smartness in a city through technology. The fourth and a frequently discussed imperative is social infrastructure include primary healthcare facilities, children's play and recreation facilities, services for young people, older people and disabled people, as well as libraries, sports and leisure facilities, open space, schools, nurseries and other childcare provision, training facilities, fire and policing facilities, community halls, meeting rooms, places of worship, public toilets, facilities for cyclists, convenience shops, banking facilities and post offices. The Smart Cities Mission needs to initiate this to gain both short-term (such as meaningful utilization of investments under various schemes) and long-term benefits (such as initiating important structural reforms in urban planning and management processes, empowered by technology). Only such a holistic approach; which balances the human development, infrastructure and environmental aspects; and formulated with the active participation of the residents of a city, can make it SMART in the long run.

Citizens don't want to have to think about the services they receive — they simply want to enjoy them. When a holistic approach to system services is taken, things work in greater harmony. "To provide efficient services in Smart Cities, a number of correlated sources of information should be brought under a common platform and data from such sources should be processed simultaneously. This paper aims to develop a holistic model for high-performance urban living based on the concept of sustainable development. The big challenge in urban sustainability is to develop comprehensive policies that are consistently applied over different municipal areas. These policies need to be based on a broad and comprehensive understanding of the different factors that influence the relationship between the way cities operate and the environment. Smart cities are seen as a key to India's economic and social growth.

2. REVIEW OF LITERATURE

India's population is no doubt increasing; quality of life of citizens in urban areas is declining. Moreover, unchecked migration from rural areas is only putting further strain on the infrastructure in cities. The result is water and power shortages, lack of proper sewage collection and treatment, overburdened transport systems and unplanned constructions.

A 2010 study conducted by McKinsey Global Institute (MGI) Titled 'India's urban awakening: Building inclusive cities, sustaining economic growth' estimates that by 2030, 40% of India's population will be living in cities. This makes it all the more crucial for us to ensure that the process of urbanization occurs in a smooth and phased manner.

Infrastructure services make a city "livable." These fundamental services, both necessities and comforts for citizens and businesses. *Cities are faced with the challenge of keeping people on the move, providing a reliable, cost-effective supply of power and ensuring safe, secure and intelligent buildings. Thanks to the digitalization of infrastructures, cities can boost performance, lower costs and improve resource efficiency. Romer (1986, 1990), Lucas (1988) and Barro (1990) have paved the way for the emergence of an entire class of endogenous growth models that seek to explicitly indigenize human capital accumulation and infrastructure as two of the main arguments of the aggregate production function.*

In this regard, Nasscom", there are concerns in some sections regarding the fact that just implementing technologies is not the way a 'smart city' would work. "That is the reason why we are looking at three aspects such as helping the local economy, environmental sustainability and social cohesiveness as pre requisites of a 'smart city'.

There is no one-size-fits-all solution to the challenges facing our cities, but the issues need to be considered together. From the urban design and planning point of view, the well-connected open city is a powerful paradigm and an engine for integration and inclusivity," said Richard Rogers, a British Architect in the Future of London's Property Market debate in February 2013. Today, academic research and industrial applications in the area of Smart Cities develop a holistic model for high-performance urban living based on the holistic approach. It's high time the government understand that a smart city should be a socioeconomic development concept instead of only a technological one. The mere adoption of technology will not guarantee the success of smart cities.

3. RESEARCH METHODOLOGY

The research has been conducted with the following objectives in view:

1. To determine the integrated infrastructure which maximize the acceptability and transparency to gain endeavor smart cities. It requires a centralized structure.
2. To find the infrastructure as a opportunity and a pre requisite for making cities smart and sustainable with a smart people.
3. To understand and evaluate the urbanization impact on quality of life and multi-faceted pressures of urbanization that will force cities to develop efficiencies and strategies in order to remain viable with fewer resources.

Based upon the fundamental objective of the research the study attempts to understand the impact of infrastructure on endeavor and envision smart cities challenges and point out that intricate relationships exist between various urban systems, which is why analyzing them holistically can reveal relationships and insights that may have previously been unknown. He also stresses that adding social media monitoring into the mix can help identify emerging problems.

The research under study is descriptive in nature to understand the sustainable development of cities and a more matured and developed nation by the help of holistic and integrated infrastructure which balances the *human development*, *infrastructure* and *environmental* aspects for the better development of urban system.

As the vast majority of today's global infrastructure operates in a metaphorical vacuum. Governments, municipalities and, all too frequently, critical service providers look at infrastructure networks as individual and unrelated systems. This practice leaves them open to resource inefficiencies and operational risks, and fails to recognize synergistic opportunities. To better manage limited natural resources and more effectively harness these synergies, it is necessary to view each component as part of an integrated network.

4. DATA ANALYSIS AND INTERPRETATION

A developed urban area that creates sustainable economic development and high quality of life by excelling in multiple key areas; economy, mobility, environment, people, living, and government. Excelling in these key areas can be done so through strong human capital, social capital, and/or ICT infrastructure. But Smart cities are not simply the proliferation of a lot of intelligent devices. It is based on many large infrastructure groups interacting with each other across platforms. Examples include energy utilities that make investment decisions based on the relationships between their fuel delivery, generation, transmission, distribution and customer processes. Similarly, the water, energy, telecom and transportation infrastructure of future smart cities can make the systems more adaptable and reliable while helping to make residents' lives more sustainable.

This calls for a holistic infrastructure and how should city leaders prioritize the projects they take on? I suggest that Maslow's Hierarchy of Needs is a good place to start. As shown in the following diagram, the most important needs start at the bottom with necessities (food, water, and sanitation) the next set of needs involves safety concerns (police, fire, transportation) and the final set of needs involve belonging and touch on operational concerns (transportation, electricity, etc.). A well-run city then fosters an environment that allows its citizens to satisfy needs even higher on Maslow's Hierarchy.



Fig. 1

Improving efficiency of city services and facilitating a more sustainable development of cities are the main drivers of the smart city concept. It is that just implementing technologies is not the way a 'smart city' would work. "That is the reason why we are looking at three aspects such as helping the local economy, environmental sustainability and social cohesiveness as pre requisites of a 'smart city'". Today, academic research and industrial applications in the area of Smart Cities seek to optimize existing city infrastructure, networks, and urban behavior through the deployment and utilization of digital networks. Cities that employ optimization techniques have reported improvements in energy efficiency, water use, public safety, road congestion, and many other areas. However, optimization has its limits. For instance, the improvement of traffic flow in most cities can approach 10% based on current Smart Cities approaches such as sensing the road network, predicting the demand, and controlling traffic signaling. Research and investments in new urban systems are fundamentally critical because optimization will have little effect for rapidly urbanizing cities such as Bangalore, India, which experience around the clock congestion. This course moves beyond Smart Cities by focusing on disruptive innovations in technology, design, planning, policy, and strategies that can bring dramatic improvements in urban livability and sustainability. This paper aims to develop a holistic model for high-performance urban living based on the concept of Compact Urban Cells and introduce the following key elements for Compact Urban Cells:

1. In terms of infrastructure, the smart cities should have 24x7 availability of high quality utility services like water and power.
2. A robust transport system that emphasizes on public transport is also a key element.
3. In social infrastructure, the cities should provide opportunities for jobs and livelihoods for its inhabitants.
4. The smart cities should also have proper facilities for entertainment and the safety and security of the people.

State-of-the-art health and education facilities are also a must.

- The smart cities should minimize waste by increasing energy efficiency and reducing water conservation. Proper recycling of waste materials must be done in such cities.

5. SMART AND INTEGRATED SOLUTION

Citizens want urban systems to be effective and run efficiently. Just consider the outcry that occurs when a water mains break, or buses and trains stop running, or potholes goes unfilled, or sewage backs up, or garbage goes uncollected, or the lights go out. Citizens don't want to have to think about the services they receive — they simply want to enjoy them. When a holistic approach to system services is taken, things work in greater harmony.

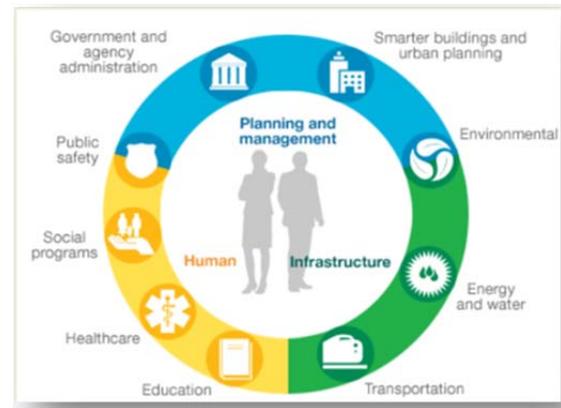
“To provide efficient services in Smart Cities, a number of correlated sources of information should be brought under a common platform and data from such sources should be processed simultaneously.

The need of the hour is that a city needs to be sustainable in order to be smart. This will mean that the interventions under the Smart Cities Mission need to align their goals, objectives and processes to the overarching principle of sustainability. Infrastructure have continue to apply new technology, connectivity and data processing, making it more integrated, flexible and sustainable and offers the ability to address the collective needs of various stakeholders in the community, including utilities, co-producers, major industrials, universities, campuses and retail customers.

6. INTERPRETATION

Building smart cities does not involve the construction of smart homes alone. It involves smart usage of energy, smart integration, smart mobility, smart public services, smart waste management etc. “In India, giving priority to the pedestrians is not the norm. Vehicles have more road space. In order to achieve smart mobility, we need to priorities walk-ability and pedestrian connectivity. In countries like Hong Kong, 90 per cent of the population travels by public transport. “We have still not achieved a fool-proof system to manage our solid waste. Ours is a country where people still dump garbage on the roads. Until there is a change in the mentality of the people, there is no point in just building smart homes.”

Thus, while real estate seems to be warming itself to the concept of smart living, there is still a long way to go before smart homes become a norm. Firstly, smart living and smart thinking by the people needs to become a norm. Everything else will then follow.



By 2050, it is projected that 67% of the global population will live in cities. Every day, urban areas grow by almost 150 000 new people, either due to migration or births. Smart Cities are necessary to reduce emissions and to handle this rapid urban growth. However cities, as we know them, are faced with a complex challenge – the traditional processes of planning, procuring and financing are not adequate for the needs of Smart Cities. Their development requires the right environment for smart solutions to be effectively adopted and used. To prosper and avoid major issues, cities must achieve economic, social, and environmental sustainability and become "smart cities" in the future. This can only be realized by integrating their infrastructures and services to improve urban efficiencies. All cities aiming to develop into smart cities have to be built on three sustainability pillars:

Environmental sustainability: - Cities face a number of environmental sustainability challenges, generated by the city itself or caused by weather or geological events. To reduce the impact of the city on the environment resource it is important to promote the efficient and intelligent deployment of technology and to integrate infrastructures. This process can also be developed in such a manner as to increase the resilience of the city to environmental shocks.

Social sustainability:-A city's attractiveness for people, business and capital is closely related to the quality of life (QoL), business opportunities and security and stability, which are guaranteed by social inclusiveness. In a smart city, it is important to take into account the risks of alienating important groups of citizens. This may happen because smart services are limited to richer areas of the town, or because user charges make many important services unaffordable for certain parts of the population.

Economic sustainability:-Cities need to provide citizens with the capacity to develop their economic potential, and attract business and capital. With the global financial crisis, the economic sustainability of cities has taken centre stage. The crisis has unearthed considerable weaknesses in the financial models and planning strategies of public authorities in the provision of services and in their infrastructure investments. Their financial sustainability now depends also on new

financial models, as well as more efficient and better-integrated services and Infrastructures.

Presently, however, smart city projects concentrate mainly on vertical integration within existing independent infrastructure and services silos, e.g. energy, transport, water or health. A truly “smart” city requires horizontal integration as well as creating a system of systems capable of achieving considerable increases in efficiency and generating new opportunities for the city and its citizens.

7. FINDINGS AND CONCLUSION

The pace of urbanization at the global level is unprecedented. Every day, urban areas grow by almost 150 000 new people, either due to migration or births. Between 2011 and 2050, the world’s urban population is projected to rise by 72 % (i.e. from 3.6 billion to 6.3 billion) and the population share in urban areas from 52 % in 2011 to 67 % in 2050. A smart city cannot be imposed by decree, as the city is shaped by a large number of individual decisions and social and technological changes cannot be fully accounted for. With the present advances in telecommunications, information and communication technologies (ICT) and affordable energy efficiency and energy production tools are changing the relationship between citizens and city services. Citizens are increasingly becoming providers of city services and not only users. A good plan requires the participation, input and ideas from a wide range of stakeholders within the city. This *means that city* planning needs to allow for bottom-up processes of modernization. The stakeholders are:

- Political leaders, managers and operators of the local government (city).
- The service operators – public or private: water, electricity, gas, communication, transport, waste, education, etc.
- End users and producers: inhabitants and local business representatives.
- Investors: private banks, venture capitalists, pension funds, international bank.
- Solution providers: technology providers, financiers and investors.

Giving to each of these groups a true stake in smart city development is important to achieve the necessary consensus for the changes. Their concerns need to be carefully considered and acknowledged, and ultimately the direction and next steps have to be collectively approved. In the absence of proper consultation, the authorities will sooner or later face considerable additional obstacles to make their vision a reality. Without integration rising to the level of a system of systems there cannot be smart cities. The successful development of a smart city will require the combining of a bottom-up systems approach with a top-down service development and a data-

centric approach. Technology integration includes vertical integration from sensors, to low cost communication, real time analysis and control, and horizontal integration of historically isolated systems up to citizen based services. Combined, this creates a system of systems.

The ability to effectively and efficiently manage rapid urbanization will become essential. Cities need to reach, achieve and maintain the essential objectives of economic, social, environmental and financial sustainability. For *this, they will require increasing the efficiency of existing and new infrastructures and services to a level never achieved before. This will require a leap in integration of all infrastructures, whether they are public or privately funded or operated and this relates to management and operations. There is a consensus that the daily life of all citizens will be influenced by the degree of smartness of the solutions, the degree of user-friendliness as well as the costs incurred. All models of development of cities have to ensure that public transport, water, sanitation, electricity, and telecommunications are affordable and accessible to all population groups. With the help of core infrastructure elements (Adequate water supply, Assured electricity supply, Sanitation, including solid waste management, Efficient urban mobility and public transport, Affordable housing especially for the poor, Robust IT connectivity and digitalization, Good governance especially e-Governance and citizen participation, Sustainable environment, Storm water drains to reduce flooding, Pedestrians, non-motorized and public transport facilities and parking spaces, Safety and security of citizens, particularly women, children and the elderly, and Health and education.)*

8. FUTURE RESEARCH

The scope of the research was to discuss the impact of infrastructure and innovative ideas for the success of cities. A critical challenge is to ensure the pieces are combined and laid out correctly. This is why in addition to technology development and integration efforts, cities need to change their approach to planning and management. As One risk of not having the appropriate type and level of integration of city infrastructures and services would be the simultaneous loss of electrical power, water supply, and gas supply and telecommunication networks. When the different sub-systems do not have integrated backup power or control and operational systems, but are wholly dependent on a common power grid or communication network, they can become single points of failure.

Urban safety and resilience are becoming a central issue in debates about the future of cities.

The future study focus on comprise of special economic zones, or investment regions, with modified tax structures and regulations to make it ripe for investment from foreign countries/companies. One of the core components of a smart city is sustainable living and offering better quality of life to

the entire population. This includes developing more affordable options, mainly housing. Smart affordable housing consumes utilities resourcefully (e.g. power and water) and would enable a majority of people to lead a comfortable life while conserving the environment.

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