

Smart Infrastructure for Sustainable Smart Cities

Ar.Likhita Devineni (Assistant Professor) [1], **Ar.Adireddy Anusha** (Assistant Professor)[2]
[1][2]School of Architecture, Dayananda Sagar Academy of Technology & Management, Bangalore.
Email: likhita.a@gmail.com, anusha.adireddy@gmail.com

“Smart infrastructure has the ability to influence and direct its own use, maintenance and support by responding intelligently to changes in its environment.”

Abstract — This paper aims at developing the urban community level infrastructure, which is represented by physical and economic infrastructure. This can be a long term goal and cities can work towards developing such comprehensive infrastructure incrementally, adding on layers of ‘smartness’.

Cities are engines of growth for the economy of every nation, including India. Nearly 31% of India’s current population lives in urban areas and contributes 63% of India’s GDP (Census 2011). With increasing urbanization, urban areas are expected to house 40% of India’s population and contribute 75% of India’s GDP by 2030. This requires comprehensive development of physical, institutional, social and economic infrastructure. All are important in improving the quality of life and attracting people and investments to the City, setting in motion a virtuous cycle of growth and development. Development of Smart Infrastructure is a step in that direction.

the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of ‘Smart’ Solutions.

Keywords— Urbanization; Sustainability; Smart infrastructure ; Green infrastructure; Technology; Growth.

I INTRODUCTION

As world populations migrate to urban areas, cities are faced with new challenges. These include traffic jams, overcrowding, pollution, resource constraints, inadequate infrastructure and the need for continuing economic growth. It has been recorded since several years that a rapid urbanization is happening across states of India. Infrastructure is not exactly the emphasized word in architecture. The importance of

infrastructure for sustained economic development is not well recognized yet. Physical infrastructure covering transportation, power and communication through its backward and forward linkages facilitates growth, social infrastructure including water supply, sanitation, sewage disposal, education and health, which are in the nature of primary services and has a direct impact on the quality of life. There are no professionals who proudly boast about their pipe designs or subsurface drainage systems etc. By its very definition – the underlying structures that support our systems – infrastructure is inherently hidden from us, and therefore often overlooked. But without it our current cities couldn’t possibly exist. The performance of infrastructure is largely a reflection of the performance of the economy. Without finding ways to improve it, our future cities will struggle to survive.

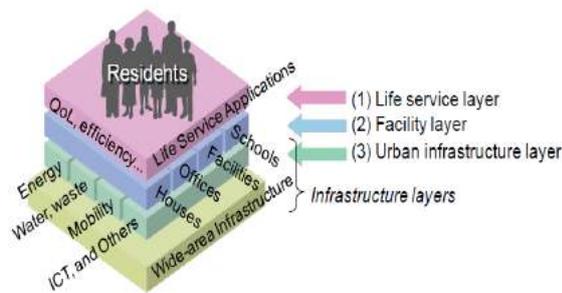
In the more distant past, construction has been a driven by localized issues such as sanitation, flooding or fire. The reaction has been to engineer systems (under the powers of centralized, state-led planning and public funding) that solve a single problem at a particular time. Little thought has been given to future conditions. But, rather than being reactive, future infrastructure designs will need to be anticipatory and proactive to be truly sustainable. Much like an ecosystem, these will contain many small-scale, networked elements that serve a multitude of uses, rather than one single guiding purpose for their existence.

Cities will need to accurately measure current conditions and model the future. Sensors and technological controls embedded within new and retrofitted urban designs could monitor existing conditions and provide real-time feedback in case modifications are needed. Infrastructure designs will not only have to anticipate short-term, local conditions, but long-term, global phenomena as well. Another important component is the shift from single-function to multifunctional infrastructure. Past designs solved one particular problem for an isolated part of the larger system – water, waste or transportation. It’s a fairly radical rethink, but the



networked nature of our future cities will allow infrastructures to cross sectors and serve many interests.

One example is urban waste. It currently serves the sole purpose of moving water and solid waste far away from human settlements. Future designs could instead see these waste flows as resource flows, and reconnect other essential city services together. This is already starting to happen; in southern California, wastewater has been converted into drinking water, which is potentially cleaner than what is found in snowmelt.



II ANALYSIS

The three major components to be followed in developing infrastructure of an existing or for a future planning of a city are: study the community, develop a policy and engage the community

1. **Study the Community:** Before deciding to redevelop or to build a city, first we need to know why. This can be done by determining the benefits of such an initiative. Study the community to know the citizens, the business's needs - know the citizens and the community's unique attributes, such as the age of the citizens, their education, hobbies, and attractions of the city etc.
2. **Develop a Policy:** Develop a policy to drive the initiatives, where roles, responsibilities, objective, and goals can be defined. Create plans and strategies on how the goals and objectives will be achieved/implemented.
3. **Engage the Citizens/Community:** This can be done by engaging the citizens through the use of e-government initiatives, open data, sport events, etc

In short, People, Process and Technology (PPT) are the three principles of the success of a smart infrastructure initiative. Cities must study their citizens and communities, know the process,

business drivers; create policies and objectives to meet the citizens needs. Then technology can be implemented to meet the citizens need, in order to improve the quality of life and create real economic opportunities.

Remediation may have to be performed before development can proceed. However, out there in the cutting edge, innovative urban planners, policy-makers, social entrepreneurs and impact investors are advancing the development of smart and green infrastructure.

The communities of the future will be smarter about their use of resources. That seems inevitable. More investment is flowing to technologies such as upgraded power grids with smart meters that allow users to better manage their consumption of electricity, and energy-efficient buildings that reduce the cost of operations and improve human health through better air quality. An emerging area that is gaining momentum and deserves the attention of impact investors is smart infrastructure.

Smart infrastructure can also be linked with Green Infrastructure which can be defined as "solutions that manage storm water onsite through installation of permeable pavement, green roofs, parks, roadside plantings, rain barrels, and other mechanisms that enhance natural hydrologic functions, such as infiltration into soil and evaporation into the air."



IV EXAMPLE

POWER SUPPLY MANAGEMENT, BEING AN IMPORTANT TRIGGERING INFRASTRUCTURE ISSUE IN CURRENT COUNTRY CONDITIONS.

AMSTERDAM:

The Amsterdam Smart City initiative which began in 2009 currently includes 79 projects of smart infrastructure collaboratively developed by local residents, government and businesses. These projects run on an interconnected platform through wireless devices to enhance the city's real time decision making abilities. The City of Amsterdam



(City) claims the purpose of the projects is to reduce traffic, save energy and improve public safety. An example of a resident developed app is Mobypark, which allows owners of parking spaces to rent them out to people for a fee. The data generated from this app can then be used by the City to determine parking demand and traffic flows in Amsterdam. The Amsterdam New West district contains approximately 40.000 households, of which around 10.000 are served by Alliander's new Smart Grid. New West has a high penetration of smart meters and contains the largest amount of solar panels in Amsterdam, with incentives provided to those that actively reduce energy consumption. This intelligent electricity network (Smart Grid) contains additional computers and sensors placed in the grid. As such current and voltage are monitored continuously to provide more accurate monitoring and control functions. The Smart Grid provides us with better and cheaper options to facilitate the energy transition and latest developments. Consumer benefits:

- Reduction of the number and duration of power outages
- Better opportunity to feed consumer-produced electricity back to the grid
- Increased capability to support the integration of electric-powered vehicles
- Prevention of large price increases for electricity transmission
- Enablement of active participation in a sustainable energy supply.

Other initiatives include flexible street lighting which allows municipalities to control the brightness of street lights, to align current developments and further ambitions in the field of sustainable power supply in New West, this district has been chosen for the construction of the first smart grid in the Netherlands. Even smart traffic management is introduced, where traffic is monitored in real time by the City and information about current travel time on certain roads is broadcast to allow motorists to determine the best routes to take.

Smart cities are necessary not only to reduce emissions, but to handle the rapid urbanization growth that the world is experiencing. Inefficiencies in urban areas bring large negative environmental and social impacts. City infrastructures are the backbone of the cities, delivering the necessary services to the population and creating the conditions for citizens to develop their professional, social and cultural activities. Infrastructures are also quintessential in guaranteeing the city's resilience to environmental risks.

Until now city infrastructures have been built independently and operated separately in parallel silos (water supply, electricity, transport).

Furthermore, the citizen has mainly been a consumer of services with little direct influence on the system. In a smart city, this needs to change. First of all, efficiency requires that infrastructures are appropriately interlinked horizontally. Secondly, citizens are becoming producers and service providers. In the area of energy, individuals are starting to produce energy from renewable and thanks to the data revolution, also to deliver information and services in a number of areas.

With smart systems, goods owned by citizens can be active in improving efficiency. Smart meters and electric cars can interact with the grid, data produced by the smart applications of the citizens can contribute to traffic control, improve emergency response, etc. Citizens can also use the technologies to sell new services. This change in cities needs to be accompanied by enabling conditions, which means reforming the ways cities are governed and financed, i.e. administrative reforms and new financial systems.

However, the glue allowing infrastructures to link and operate efficiently are standards. Standards are necessary to ensure interoperability of technologies and the transfer of best practices. But standards are not yet adapted to the level of technology integration we are requiring. Standard bodies still operate in sectorial parallel silos, developing standards which are not easy to understand by non-specialists, particularly city managers. Standards are facilitators for city planners, and they need to incorporate standards in planning and procurement. There is thus a need to reform the way standards are produced, ensuring those are adapted to the needs of the city planners and other service operators within the city.

There is a need for close collaboration between standard bodies themselves and collaboration with outside organizations, in particular the city planner.

V CONCLUSION

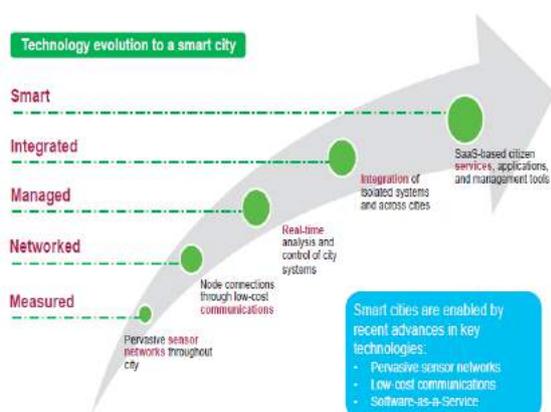
The largest democracy of the world had recently voted for the change and we have a new government, which everyone has high hope from. They need to now bring in lots of confidence in private sector to invest in Infrastructure and also at the same time make the process simpler by tightening the noose of officials responsible for posing the hurdle for vested interests.

The development of India's infrastructure presents a huge task as well as a huge opportunity. The previous sections have raised some of the key issues that will need to be addressed for a major step-up in infrastructure development. But there are other challenges too. It is important to draw attention to some of them in particular. The first concerns the environment. Building good quality infrastructure is integral to the development of a



competitive Indian economy that is expected to play a larger role in the world economy. And building it rapidly with the least damage to the environment is important. How the huge growth in power generation, transportation and urbanization can be managed is therefore especially important. A second issue is the importance of transparent processes of bidding and procurement if a PPT is to play a major role. Fairness and a level playing field must be firmly established and not perceived to be compromised at any stage. There is no doubt that India's infrastructure is a growth sector: it is clearly recognized as a national priority. The infrastructure will be built. The question is how well will the process be managed: how sustainable, transparent and fair will it be? We will have to take the following steps:

- We will have to build new smart cities to accommodate the surge and shift of population. The basic premise of the design of these new cities must be that these new city projects are considered as Infrastructure projects and not real estate projects. Infrastructure shall be the key. These cities shall be green, sustainable, livable and a well planned integrated development
- Improve infrastructural facilities and help create durable public assets and quality oriented services in existing cities & towns.
- We will have to create conducive working environment to give a boost to private investment under PPT model for sustainable development.



With the Twelfth Plan focusing on attracting private sector to fund about 50% of the total infrastructure investment target, there is need to start both short-term actions and long-term measures at the earliest including the smart ways to

improve it keeping future development in mind. Fiscal support will continue to be dominant for infrastructure development but equally important would be the enabling policies that could lead to streamlining of procedures and protecting interests of both investors and consumers. If we put some of the recommendation above into practice, smart infrastructure dream can be realized and place India's economy on a high growth trajectory.

REFERENCES

1. directionsmag.com/entry/sustainable-cities-where-smart-infrastructure
2. amsterdamsmartcity.com/
3. smartcities.gov.in/writereaddata/SmartCityGuidelines.pdf
4. www.ibm.com/smarterplanet/in/en/smarter_cities/infrastructure

AUTHORS PROFILE

Ar.Likhita Devineni has pursued B.Arch from JNTU, Hyderabad and M.U.R.P from JNTU, Hyderabad. She has overall 7 years of experience in Industry as an Architect and 1 year of teaching experience. Currently working as Asst. Professor at Dayananda Sagar Academy of Technology And Management, Bangalore, Karnataka

Ar. Anusha Adireddy has pursued B.Arch from DSCE, Bangalore and M.Arch from BMSCE, Bangalore. She has overall 4 years of experience in teaching as well as industry. Currently working as Asst. Professor at Dayananda Sagar Academy of Technology And Management, Bangalore, Karnataka

