

SMART SOLUTIONS FOR SUSTAINABLE CITIES:

A POLICY PERSPECTIVE



Introduction

Urban India has grown at an unprecedented rate in the last two decades. The level of urbanization increased from 25 per cent in 1991 to 31 per cent in 2011 with a total urban population of 377 million in 2011. A conservative estimate of India's population growth shows that it is expected to reach about 1.5 billion by 2031, of which the urban population is estimated to be about 600 million, i.e., about 40 per cent¹. The contribution of urban areas to the national GDP is expected to increase from about 60 per cent in 2009–10 to about 75 per cent in 2030² indicating the continued trends in terms of cities being the engines for economic growth of the country. The potential of cities and their contribution to the economic growth, however, could remain underachieved if the current and future challenges of urban development linked to gaps in the provision of basic services and housing to all, infrastructure development, and an environment-friendly growth are not addressed adequately.

Amongst all challenges, provision of basic services is the most critical if an equitable and inclusive growth of urban areas is to be achieved. Equitable access to water, electricity, and mobility services are amongst the most basic services that need to be provided to urban residents to ensure their equal and efficient contribution to the economic growth of the cities. These services, however, are not available to all urban habitants and need to be augmented substantially to meet the needs of all. The current demand-supply gap in water sector, for example, is about 744 bcm and is expected to reach an alarmingly high level of about 1,500 bcm by 2030 in a business as usual case. Overexploitation of groundwater, declining water availability, and deterioration in surface and groundwater quality is an outcome of this gap and remains a constant challenge³. And, while electricity access may not be as big a challenge currently, the quality of supply is. The future growth of population will increase the electricity demand of the building sector in urban areas to about 2,37,000 GWh by 2020, which is about three times as compared to 2010–11 levels. The energy demand for residential buildings is going to be a critical component in this demand as estimates show that energy need for heating and cooling in residential segment shall increase by 180 per cent by 2021 over the present baseline, while energy need for lighting in residential

¹ Working Group on Urban Transport for 12th Five Year Plan

² Mid-term appraisal of 11th Five Year Plan, Planning Commission

³ blogs.economicstimes.indiatimes.com

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segment shall rise by 80 per cent⁴. The provision of public transport is another critical service gap that would have to be filled, especially when we are in a situation wherein formal public transport services are available only in about 50 out of about 500 Class I cities in the country.

The gaps in provision of services are associated with massive infrastructure development needs. The High Powered Expert Committee (HPEC), set up by the Ministry of Urban Development (MoUD), Government of India, for estimating the investment requirement for urban infrastructure services estimates investment requirements of about USD 64.03 billion (Rs 39.2 lakh crore) at 2009–10 prices till 2031, of which Rs 30.98 lakh crore (about 80 per cent) are estimated to be required for capital expenditure in eight major sectors of urban infrastructure (Figure 1). The scale of investment requirements indicates the current shortfall and future requirements of infrastructure investments that need to be made in order to lead our cities towards higher economic growth and quality of life.

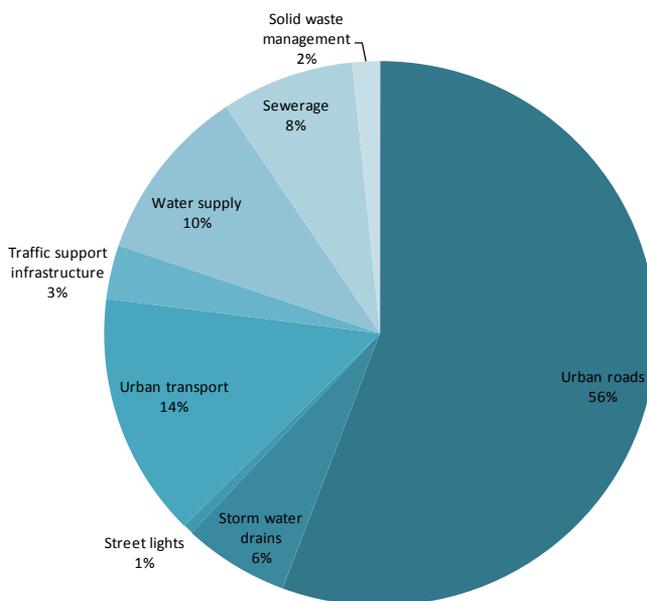


Figure 1: Relative Shares of Sectors in Investment Requirement (per cent)

Source: Report on Indian Urban Infrastructure and Services, High Powered Expert Committee (HPEC) for Estimating the Investment Requirements for Urban Infrastructure Services, March 2011, Available at <http://www.icrier.org/pdf/FinalReport-hpec.pdf>

⁴ Ibid

⁵ WHO data

In addition to meeting the gaps in provision of physical services, urban areas will also need to ensure adequate availability of social services related to education, healthcare, security, safety, recreation, etc. These services will be equally important to ensure high level of quality of life and enhance livability of India’s urban centres; Indian cities need to become safe, crime-free, healthy, pollution-free, and inclusive.

And, while provision of services and infrastructure development will be critical, it will be equally important to ensure minimal impact of urban development on environment. For example, the urban areas in India generate more than 1,00,000 MT of waste per day; the problem of waste management is expected to grow manifold and would have to be tackled in time. The pollution due to sewage and industrial discharge into water bodies would also have to be addressed along with measures to curb impact of urban activities on air pollution. We would certainly want to move away from the distinction of having most of our large cities amongst the 100 most polluted cities of the world.⁵

The above discussion clearly highlights the need for making cities the engine for economic growth of the country by adopting a path that ensures the 3Es—Equity, Efficiency, and Environment; and investment friendliness. And, this can be achieved only by leaping ahead of the conventional development path, which in turn can be enabled by learning from success of other cities and using technology in every possible facet of city development as is also imbibed in the concept of smart cities. It is important to note that this requires that procurement move from lowest acquisition cost (low-cost products are not smart and produce little sustained socio-economic impact) to lowest cost of ownership to the intelligence built into the system.



BOX 1: SMART CITIES

“The term “Smarter Cities” is broadly used to describe well-planned cities, designed to achieve high quality of life, sustainable economic growth, and prosperity for its citizens. To achieve this, Smarter Cities leverage technology, smart infrastructure, streamlined processes and governance. The goal is to use resources efficiently, make better decisions, and proactively anticipate and resolve problems.”

IBM India

“A Smart City in India is one that effectively delivers public and civil services to citizens and businesses, leveraging technology as an enabler, in an integrated and resource-efficient way while enabling innovative collaborations to improve quality of life and grow the local and national economy.”

Accenture

The next section discusses the concept of smart cities in more detail.

Smart cities

In the context of city development, the word ‘Smart’ till now has essentially been used in the context of technology-oriented solutions that end up being far more efficient as compared to the conventional solutions. This is largely achieved by deploying the use of Information and Communication Technologies (ICT).

While ICT would be a critical element of anything that is smart, mere application of ICT should not be the reason for using it for urban solutions. It should in fact be an enabler to meet the larger goals of realizing equitable, efficient and environment- and investment-friendly cities, i.e., sustainable cities, as discussed in the previous section. This paper, therefore, uses the word ‘Smart Cities’ consciously to imply solutions that are smart and help realize the vision for sustainable cities, i.e., smart solutions for sustainable cities. A similar approach is also reflected in the Government of India’s ‘Smart cities initiative’ where smartness of cities is being viewed beyond just application of technologies (Box 2). The end objective is realization of a sustainable city and smart solutions are one of the enablers for this. There are several other enablers that are to be put in place if the goal of a sustainable city is to be realized fully.

The key elements of sustainable cities that can benefit from use of smart solutions are listed below.

BOX 2: THE GOVERNMENT OF INDIA’S CONCEPT OF SMART CITIES

The Ministry of Urban Development, Government of India, in its recently released draft concept note on Smart Cities has indicated its perspective on smart cities. According to the Ministry, smart cities are those that are able to attract investments, provide good infrastructure, and simple and transparent online processes that make it easy to establish an enterprise. The Ministry identifies environment and social sustainability and competitiveness as the basic pillars of smart cities that promote quality of life, employment, and investment opportunities. Institutional, physical, and social infrastructure are identified as the three basic elements that can ensure achievement of smart cities goal of the Government of India.

Source: Draft concept note on smart cities, National Conclave of Ministers and Principal Secretaries/ Secretaries of States and Union Territories, Ministry of Urban Development, Government of India, September 2014

1. Urban planning, including planning for climate resilience
2. Urban service provision and governance, including
 - Planning of services
 - Operations and management of services
 - Citizen government interface
 - Monitoring and evaluation
 - Capacity-building
 - Inter-agency collaboration
3. Provision of social services related to education, healthcare, security, etc.
4. Planning for and action during extreme events and disasters
5. Deployment and integration of alternative energy technologies
6. Implementation of solutions to improve energy efficiency in buildings
7. Providing access to social services like education, healthcare, and other social services
8. Providing safety and security services

A framework on sustainable city architecture that uses smart solutions is provided on the next page. It clearly indicates that while ICT is an enabler for many solutions required to achieve sustainable cities, there are other solutions that may or may not utilize ICT, but are critical to achieve sustainable growth of a city. It is important hence to view the concept of ‘smartness’ in this larger context.

Smart solutions for sustainable cities

The sustainable city architecture for cities presented on the next page has its origin in the three basic sustainability pillars, i.e., social, economic, and environment sustainability. Smart solutions in any urban sector, therefore, need to enable achievement of any one or all of these sustainability goals. As an example, smart solutions for urban transport have to be rooted in basic principles of sustainable mobility, which include measures that facilitate trip reduction, shifting to public transport and non-motorized transport, transport demand management, congestion management, promotion of clean vehicles and fuels, etc. Smart solutions in transport sector, therefore, have to be aligned to achieve these objectives rather than just being efficiency improvement projects. Box 3 gives examples of some of the smart solutions that have been executed by AMCHAM member companies in various cities around the world; the objective of all these measures is promotion of sustainable mobility.

Smart solutions like GIS and hydraulic modelling for 24x7 water supply, online water quality monitoring system, systems for billing and collection of revenue, real time solid waste management monitoring systems, street lighting, etc., in provision of urban/municipal services should also aim towards the 3Es. While efficiency may be achieved through such solutions, access to these services should not get neglected and should be given equal emphasis. Similarly, the solutions deployed in the buildings sector should be aimed at reduction in overall resource consumption, be it natural resources, electricity, or water. Some of the smart solutions that are being provided by AMCHAM member companies to reduce the environmental footprint of buildings in urban areas are discussed in Box 4.

All the above-discussed and other smart solutions need to be complemented by smart urban governance, which will be further enabled by smart data systems that is the most critical element in the smart city

BOX 3: SMART SOLUTIONS FOR SUSTAINABLE TRANSPORT

Equitable, efficient, and environment-friendly transport system is vital for the socio-economic development of urban areas, which are facing an enormous increase in the demand for passenger and freight movements. In an attempt to fill this demand supply gap in urban transport sector, the service providers have focused only on the provision of additional infrastructure rather than meeting the demand in a more efficient manner. The failure of current urban transport practices to deliver socio-economic and environment-friendly solutions has reinforced the case for sustainable provision of transport services in our cities, which includes elements like provision of public transport services, ensuring safe infrastructure for non-motorized transport, congestion management, parking management, etc. Most of these sustainable mobility solutions have the potential for application of smart technologies in service provision and management. For example, use of integrated fare and congestion system technologies, as provided by IBM to several public transport operators around the globe, like in Dublin, Singapore, Stockholm, London, Brisbane, Norway can help promote multi-modal transport. As indicated by IBM, these systems help ensure seamless payment systems while using metro rail systems, buses, parking, tolls, etc., and hence increase commuters' convenience of using the more sustainable modes of transport. Accenture has also implemented similar multi-modal fare integration technologies in Ontario and Portugal. It has also implemented integrated toll management system in Portugal.

Another critical area where use of smart technologies can help bring efficiency is traffic management. 3M, for example, has installed solutions in US, Europe, and Asia (for example, Taiwan, Yamuna Express way—Delhi—Agra) to enable cars to efficiently use the road without slowing down at the toll plazas. Vehicles are issued Windshield RFID tags which are installed on the windshield and can seamlessly travel on Electronic Toll Collection-enabled lanes having 3M RFID readers without stopping to pay cash and thus saving their valuable time in the process. This enables cars to efficiently use the road without slowing down. 3M has also implemented parking management systems in the US and will soon implement similar solutions in other countries; these systems will direct travellers to the most optimum locations, thereby increasing the overall efficiency of the system. 3M has been a leader in parking management solutions having presence globally in many countries with 2000+ installations. Beijing Terminal 3 airport is one of 3Ms live installations which is helping commuters every day in managing their parking requirements.

IBM has also executed projects in Istanbul, Lyon, Dubuque, Zhenjiang and has demonstrated implementation of intelligent traffic management technologies that help reduce traffic congestion, improve incident response, optimize traffic flow, and proactively manage traffic conditions in these cities; cameras, radars, under-road loop detectors, bluetooth, and mobile phones are used to implement such intelligent traffic management systems.

Smart technologies can also be used to enhance use of electric vehicles (EVs) in cities without increasing our dependence on the existing power grids. Cambridge Energy Resources, for example, has smart technologies to provide clean energy (renewable powered) charging infrastructure for EVs that work on fast charging technology and take less than an hour to charge the vehicles. The technology is designed in a manner that users are able to use the charging facilities through their smart phones. Such applications increase the user convenience and improve efficiency, hence making the use of these sustainable mobility technologies more attractive. The technology can also be used to promote use of electric buses. Renewable powered charging infrastructure for buses can be installed at the bus stops for facilitating fast charging solutions. This can help reduce the weight and costs of such electric buses, which are few of the main barriers to introduction of electric buses.

BOX 4: SMART SOLUTIONS FOR GREEN BUILDINGS

Resource efficiency in the built environment coupled with smart monitoring of high performance buildings would enhance demand side electricity management. Coupled with renewable energy integration and implementation of smart grids, the dependence on fossil fuel-based electricity would further get reduced to help achieve smart buildings.

At a city level, detailed town planning and infrastructure development can offset high energy demand of HVAC products. UTC offers advanced technology products and concepts like district cooling systems, radiant cooling, geothermal systems (renewables), variable refrigerant flow systems which can offer approximately 30 per cent energy savings. At a city level, optimization of city lighting infrastructure has exhibited significant savings. The 40W equivalent LED 3M advanced light emits the same amount of light as a 40W incandescent bulb. Yet the 3M LED bulb only uses 8.5W of electricity. In other words, it uses 79 per cent less energy than an incandescent bulb while emitting the same amount of light. The 3M film solutions help enhance light intensity and thus save 40 per cent consumption requirement of the billboards and sign boards.

3M film solutions are being utilized for building external glass walls and help in reducing sunlight heat component from entering the premises by upto 70 to 80 per cent. This helps in reducing air conditioner power consumption for buildings and helps reduce carbon footprints enabling them to become smarter in the process.

At a building level, in addition to integration of other smart measures such as controls and lighting, implementation of energy efficient HVAC systems in projects by Ingersoll Rand and UTC has helped achieve resource optimization at a national scale. Incorporating green buildings and integrating demand response measures along with smart grids, smart metering and net metering shall enable an integrated design and implementation of smart cities. Smart and energy efficient elevators and escalators offered by UTC help to meet transportation challenges, reduce peak time congestions, enhance the people productivity and improve energy efficiency by generating electricity from waste mechanical energy.

UTC can provide **integrated security systems** to manage safety of critical infrastructure and public safety, by deploying multiple subsystems (access, intrusion, video surveillance, fire Safety and monitoring). **Integrated video analytics** can provide solutions for smart city surveillance and monitoring with real time information for crime and loss prevention. In addition, UTC can provide **mass notification emergency communications** solutions for highly dense public spaces as encountered in India, aiding timely response and disaster management.

In order to ensure an integrated and holistic approach to achieving smart buildings in smart cities, Accenture and Ernst and Young (EY) have followed strategies that facilitate implementation at a much larger scale as well.

business. Experiences of AMCHAM companies like Accenture, IBM, EY, etc., indicate that smart data and governance form the most basic and critical elements for successful achievement of sustainable cities. They enable scientific planning of urban development and services, efficient delivery and management of services, easy citizen-government interface, and also aid in effective monitoring and evaluation. As indicated by IBM, efficient collection, management, and analysis of data in cities can unlock a plethora of smarter city capabilities without significant operational disruption or capital investment. Experience of Accenture in smart cities projects in Yokohama, Singapore, etc., reiterate the importance of smart data systems for cities. The most critical contribution of smart data systems is in terms of ensuring transparency, efficiency, and accountability, which are the most important elements for any civil society.

Opportunities in India

In order to execute the 100 smart cities programme, the Government of India envisages the climate for investment as an important component of smart cities, with a focus on making each city an attractive

ACCENTURE CASE STUDY

Intelligent Bandra Kurla Complex, Mumbai

Business Challenge: Bandra Kurla Complex (BKC) was instituted by MMRDA to create an easily accessible financial and business hub; MMRDA now wants BKC to develop into an intelligent city. In the initial engagement MMRDA with Accenture had identified five intelligent city solutions for implementation. MMRDA wanted to move to the next step and needed to identify the most viable options to implement.

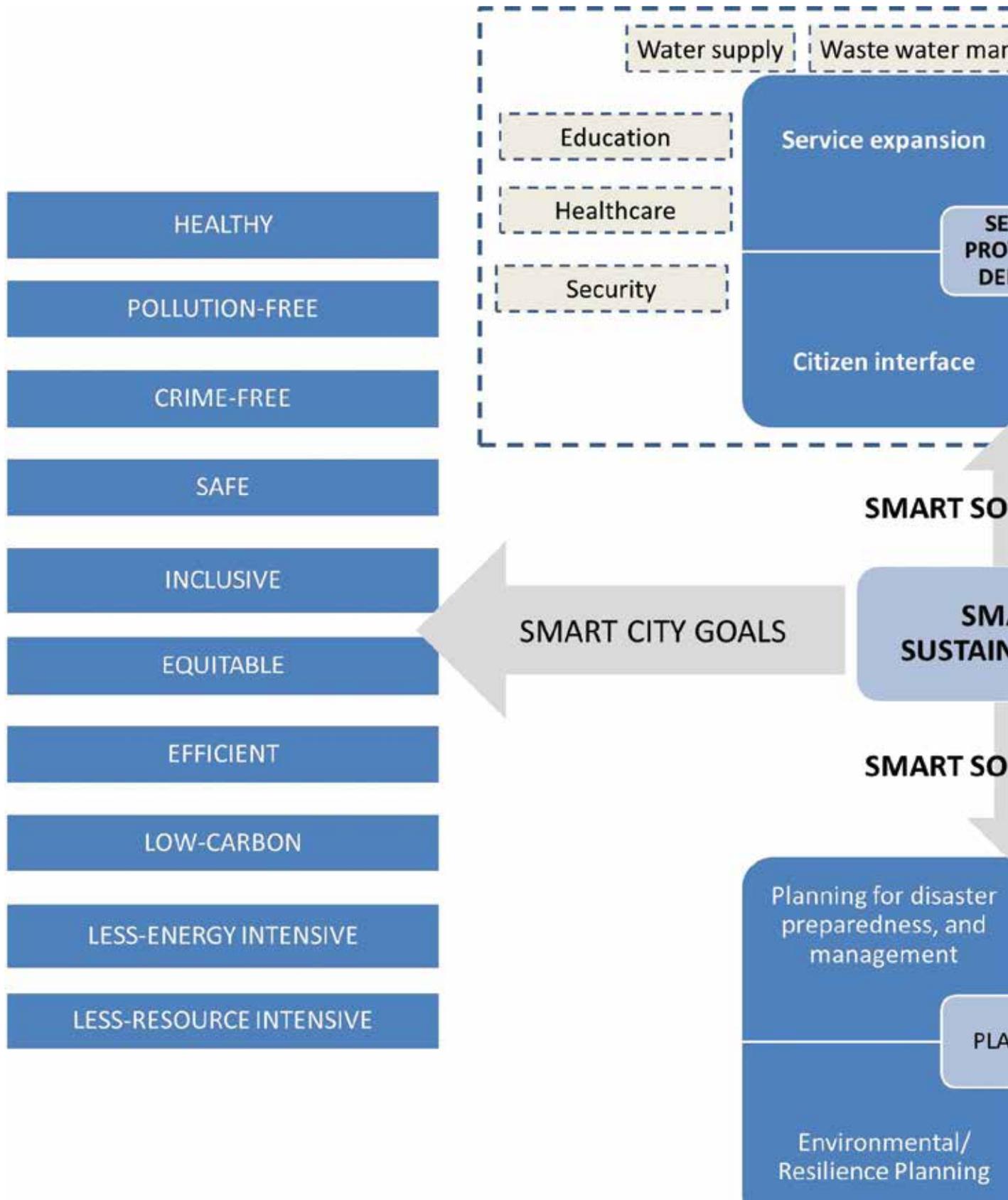
How Accenture Helped

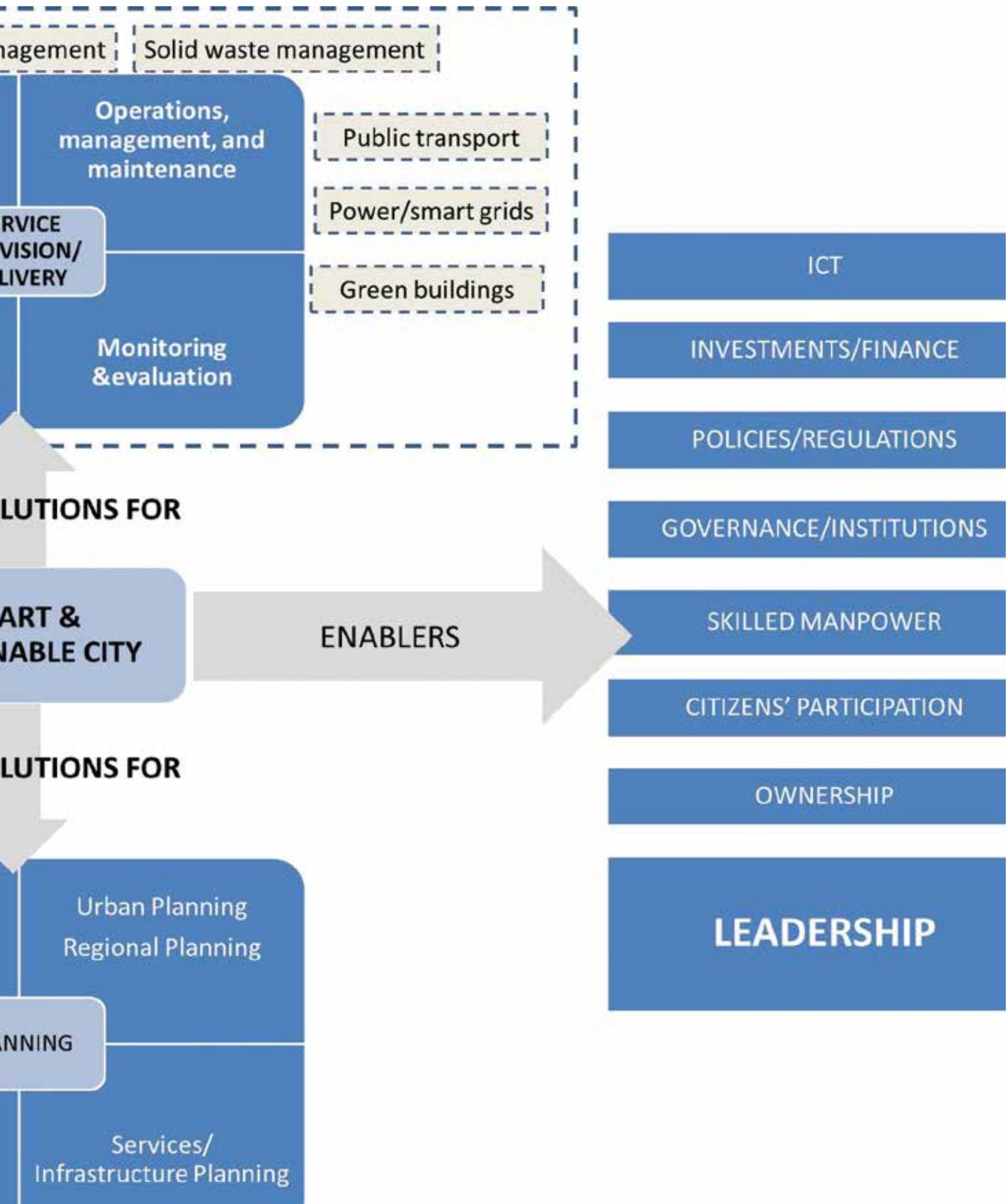
MMRDA wanted Accenture to evaluate the five selected solutions on the following parameters: Use Case, Design Architecture, Financial Viability, Stakeholder Benefits, Vendor Landscape, and also provide relevant case study examples and recommend the feasible option. The five options were:

- *BKC-wide Wi-Fi:* Providing seamless Wi-Fi coverage throughout BKC
- *Smart parking:* Installing sensors in existing parking lots to enable citizens to park smartly
- *Intelligent streetlights:* Installing time and motion sensors, solar panels and LED lights on streetlights
- *Video surveillance and analytics:* Installing PTZ and fixed cameras at important areas and running analytics on the camera feed to identify anomalous situations
- *Citizen app:* A one-stop shop app for all things BKC related from signing up for smart parking to knowing about restaurants in the area

investment destination. Therefore, the idea to make use of and channelize the private sector funds and investments has been deliberated at various levels.

Sustainable city architecture that uses smart solutions





The MoUD is in the process of drawing up its scheme for 100 Smart Cities. The Ministry in its recently published concept note on the scheme has attempted a broad estimate of the investment requirements for smart cities. The Ministry uses the per capita investment cost estimates of the HPEC for this purpose. The HPEC estimates per capita investment cost requirement of about USD 712 (Rs 43,386) for a twenty year period from 2012–13 to 2031–32. The estimates include water supply, sewerage, sanitation, and transport-related infrastructure. Assuming a typical population of one million in each of the 100 smart cities, the estimate of total investment requirement for the services covered by the HPEC is about USD 117 billion (i.e., Rs 7 lakh crore) over a period of 20 years (with an annual escalation of 10 per cent from 2009–10 to 2014–15), amounting to an annual requirement of about USD 5.8 billion (Rs 35,000 crores).

The Ministry expects that most of the infrastructure-related activities will be taken up through private investment or in public-private partnership mode. The Government of India and state governments will contribute largely by way of Viability Gap Funding (VGF) to facilitate private players while providing urban services. An independent fund (at the State and Central levels) that would leverage investments from the domestic and international investors, borrowings from bilateral and multilateral agencies, and bonds subscribed by national and state level land development agencies shall also be set up to blend grant funds from Centrally Sponsored Schemes (CSS) for municipal agencies.⁶

Further investments (which are yet to be quantified) to ensure the full potential of a smart city would be required for housing, electricity, ICT, education, health, recreation, cultural facilities, sports facilities, and environmental facilities, among others (such as metro rail, monorail, mass transit systems, etc.).

The Role of AMCHAM

AMCHAM member companies are keen to contribute to the smart cities initiative of the Government of India. The relevant expertise and capability of the AMCHAM companies is highlighted in the following table.

Sector	Smart components (role of AMCHAM)	AMCHAM company
Energy efficiency: Green buildings and infrastructure	Energy management	GE India Industrial Pvt. Ltd Corporate Division–India HQ United Technologies Corporation (UTC) Ingersoll Rand 3M IBM India Pvt. Ltd Tecumseh Products India Pvt. Ltd Honeywells
	Smart metering	GE India Industrial Pvt. Ltd Corporate Division–India HQ SunPower Solar India Pvt. Ltd First Solar Power India Pvt. Ltd Honeywell
	Smart grids	GE India Industrial Pvt. Ltd Corporate Division–India HQ Applied Materials India Pvt. Ltd Innovari, Inc. Azure Power

⁶ Draft Concept Note on Smart Cities, September 2014, Ministry of Urban Development, Government of India

		Kiran Energy Solar Power Pvt. Ltd First Solar Power India Pvt Ltd SunPower Solar India Pvt. Ltd Honeywell Quanta Power
	Net metering	Innovari, Inc.
	Demand response	GE India Industrial Pvt. Ltd Corporate Division–India HQ IBM India Pvt. Ltd
	Transmission and distribution efficiency	GE India Industrial Pvt. Ltd Corporate Division–India HQ AES (India) Pvt. Ltd AMSC India Pvt. Ltd Innovari, Inc.
Smart water and waste management	Water supply distribution and monitoring system	GE India Industrial Pvt. Ltd Corporate Division - India HQ
	GIS-based leakage management	GE India Industrial Pvt. Ltd. Corporate Division–India HQ
	Online billing and collection of revenue	
	Sensor-based irrigation	
	GIS and hydraulic modelling for 24×7 water supply	
	Online water quality monitoring system	IBM India Pvt. Ltd
	Real time monitoring (OSRT) system	GE India Industrial Pvt. Ltd Corporate Division–India HQ
Smart traffic management and provision of public transport services	IT-enabled traffic management systems	GE India Industrial Pvt. Ltd Corporate Division–India HQ Cisco Systems (India) Pvt. Ltd IBM India Pvt. Ltd
	Use of ICT in delivery of public transport services	Fluor Daniel India Pvt. Ltd
	Online systems to reduce vehicle loss hours and emissions	
	Smart parking	3M
	Fare integration	IBM India Pvt. Ltd
	Signaling and smart traffic management	3M
	Fleet management	EMD Locomotive Technologies Pvt. Ltd IBM India Pvt. Ltd
	Multi-modal integration	Fluor Daniel India Pvt. Ltd

	Smart toll payment system	Datacard India Pvt. Ltd
	Smart logistics and freight management	Cognizant Technology Solutions
	Vehicle to grid technologies	GE India Industrial Pvt. Ltd Corporate Division–India HQ Cambridge Energy Resource Ingersoll Rand (India) Pvt. Ltd
Planning and execution	Smart solutions	3M Accenture EnY AECOM Synergics Hydro (India) Pvt. Ltd AT&T Communication Services India Private Limited ATC Tower Company of India Pvt. Ltd KPMG in India ICF International The Louis Berger Group, Inc. Deloitte Haskins & Sells Underwriters Laboratories

The way forward

The smart cities initiative of the Government of India is a step in right direction, with a clear goal of achieving sustainable development in cities. It is critical to draw up the basic framework for development of smart cities in India. The sustainable city architecture presented in this paper could be a good starting point for that. Going forward, the Government of India has drawn a roadmap for implementation of its 100 smart cities initiative. The following components may also be integrated in the vision document of the Government of India:

- Identification of initial set of cities based on demographics, willingness to participate, economic, social, and environmental parameters
- Creation of sectoral baselines to assess needs, gaps, and future needs based on growth parameters
- Setting implementable goals and targets and prioritizing goals
- Seeking citizens' participation and raising awareness level of citizens by using social media and smart applications
- Preparing integrated framework for implementation

and avoiding duplication of initiatives to avoid resource wastage

- Devising sectoral policies, guidelines, and regulations to complement the framework.
- Carrying out technology assessment and mapping and engaging partner institutions for implementation
- Engaging with industry partners
- Creating robust financial structures to realize the vision and to maintain it
- Most importantly, creation of sense of ownership among each and every citizen and build capacities in urban local bodies to implement, monitor, and maintain

AMCHAM India and TERI will be keen to support the Government of India in implementing its 100 Smart Cities initiative. AMCHAM India companies and TERI are equipped to work in sector-specific consortium to provide inputs on energy efficiency (in green buildings and infrastructure); smart water and waste management; smart traffic management and provision of public transport services; and planning for smart cities.

US-India Infrastructure Collaboration Platform

Focus on “Smart Cities” and “Signature Projects”

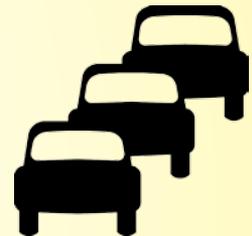
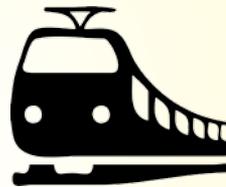
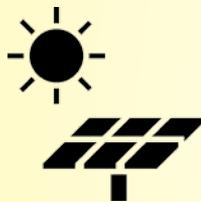
The infrastructure platform supports India’s Smart Cities initiative and is promoting it among the US companies.

To execute our infrastructure platform on the ground in India, the US Department of Commerce has a network of offices in seven cities (New Delhi, Mumbai, Ahmedabad, Kolkata, Chennai, Bangalore, and Hyderabad) staffed by 70 professionals. The US Department of Commerce is working with the Ministry of Commerce and Industry and other relevant ministries in New Delhi and state governments throughout India to identify the most appropriate and accessible infrastructure projects and invite qualified and interested US companies to participate.

US companies bring state-of-the-art technology, products, and services in the following areas:

Smart Cities Core Elements

- Project design and systems integration at the front end of infrastructure projects
- IT-enabled services
- Data analytics



Key Priority Sectors and Sub-Sectors under “Smart Cities”

Power

- Solar and renewable
- Thermal
- Energy efficiency
- Smart grids

Water and Sanitation

- Recycling
- Water treatment
- Sewage
- Desalination plants
- Water recycling

Transportation

- Railway equipment and systems
- Airports and air traffic control systems
- Aircraft maintenance, repair and overhaul
- Cold chain

Safety and Security

- Security modernization
- Safe cities
- Integrated traffic management systems

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US-India Energy Cooperation Programme

