KPMG

Road to sustainable smart cities

Challenges, opportunities and emerging trends

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Foreword

Given the fact that 34.5 percent of India's population currently resides in urban settings, and that this proportion is expected to go up to 40 percent by the year 2030, improving the quality of living for India's urban dwellers, as well as enhancing their access to better livelihoods are key to meeting India's aspirations as a nation. Many of our cities have grown organically without adequate prior planning and one of the challenges of the Indian urban administration is to retrofit features like transportation systems, power, water supply & sanitation grids onto layouts and patterns that have often grown in an unplanned manner.

The smart cities programme was launched by the Union Government in the year 2015 , with three critical programme objectives that strive to meet the foregoing challenges.

- Deploy a network of intelligent infrastructure, such as IT networks, IT-based control systems, Artificial Intelligence (AI), Command and Control Centers for improving access to essential utilities like water, power, sanitation, communication & urban mobility networks

- Retrofit modern transportation and public utility grids as well as urban planning principles into existing urban agglomerations for ensuring more orderly planning & oversight

- Mark-out greenfield areas for new city development and expansion where development can follow principles of modern-day planning with smart solutions across key themes like real estate development, transportation and utility networks, etc.

Now that we are in the sixth year of the implementation of the smart city programme, the time is right to undertake a critical evaluation of the challenges faced and successes attained so far and to undertake necessary mid-course corrections for ensuring that the eventual outcomes are met in full measure. An attempt has been made to evaluate the smart city programme across key aspects ranging from more simplified governance to programme implementation.

The findings reveal that while considerable headway has been made in attaining the objectives of the programme, further interventions are required at the regulatory, policy & programme management and design levels. It is hoped that this document will be of practical use for the key actors involved in the smart cities programme, to critically evaluate its status across these domains, and to undertake further reforms and corrections as may be warranted.

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For over a year, cities around the world have borne the brunt of the COVID-19 pandemic. Even as social isolation and gaps between different classes of society have become a harsh reality, digital technologies have played a key role in bridging this gap, while also relaying real-time life-saving information and ensuring the continuity of key public services.

A smart city is one that puts the wellbeing of its citizens at its core. As an urban community, a smart city leverages cutting-edge information and communication technologies to improve the lives of its citizens, and creatively tackle many problematic issues of contemporary city lives.

The objective of India's Smart Cities Mission is to promote cities that provide core infrastructure and improve the quality of life of its citizens, as well as a clean and sustainable environment that incorporates the application of 'smart solutions'. The initial idea behind the Mission was to internalize and fit out a hundred cities with technology that can improve living conditions & help its populace reach their full potential as productive citizens. These cities, selected through a competitive process, have focused by way of their smart city plans on sustainable and inclusive development. The idea is to create a replicable model to act like a model for other aspiring cities. The Mission is meant to set examples that can be replicated both within and outside the smart city, catalyzing the process of urbanization in various regions of the country.

India has a growing population of 1.36 billion people, about a third of whom live in urban areas, contributing to over 60% of the country's GDP[1]. However, almost 70 per cent of India's urban population lives in a little under 500 class I cities (with a population of 1 lakh or above)[2], out of nearly 8,000 cities and towns as enumerated during the Census 2011. Therefore, the key to ensuring the success of the Smart Cities Mission is to introduce smart solutions not just only to these larger cities, but also – and perhaps more importantly – smaller and medium towns as well. Urbanization is a trend that is growing rapidly across the globe, and this rate of change is accelerating the fastest in India.

We owe it to the next generation to grow responsibly, and we believe that the India that embraces digital technologies and smart solutions will also be the India that will be sustainable and capable of meeting the targets of the Sustainable Development Goals by 2030. It is the need of the hour for us to come together to learn, grow, adapt and innovate. Events such as ours bring people together to exchange ideas and collaborate for a better tomorrow.
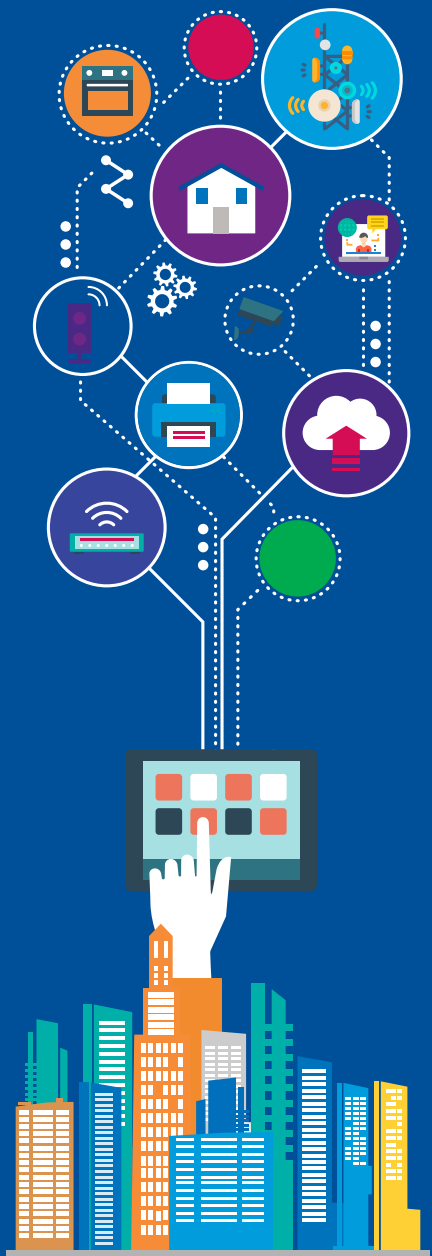
This knowledge paper, 'Road to sustainable smart cities: challenges, opportunities and emerging trends,' produced by KPMG in India will provide an analysis of the framework for helping cities build the digital infrastructure required for the Smart City transformation. The focus is on the progress made so far, while examining the key challenges, opportunities, latest trends and policies to accelerate sustainable and inclusive growth within the smart cities concept.

The knowledge partnership between KPMG in India and Exhibitions India Group is a valuable opportunity, empowered by a mutual commitment to furthering the pace of India's smart and sustainable development. We hope that this partnership will be instrumental in policy formulation, promoting innovations, smart solutions and encouraging new opportunities for overall urbanization across India.

Chandrika Behl
Managing Director
Exhibitions India
Group

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1. Census of India, 2011, CIA Factbook 2015, 12th Five Year Plan document (2012-17)
2. Summary tables from Census of India, 2011

Smart cities: The story so far

> **"**
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> **We shape our cities; thereafter our cities shape us**
>
> **Winston Churchill**
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> **"**

Urbanization in India was traditionally regarded as a natural, unavoidable phenomenon that was meant to be adapted to, as opposed to being used as a catalyst towards human development. For most of the erstwhile Five-Year Plans made up to the late 1980s, most of the funding made available to States (other than 'untied' proceeds of National level revenue) for the development of cities was to combat infrastructure shortages, development of new urban areas and combating the physical manifestation of poverty through processes such as 'slum clearance' and environmental improvement of urban slums. The social & political 'aversion' to urbanization did result in a somewhat slow rate of urbanization – which had reached only 31.16 per cent in 2011 and is expected to be around 35 per cent by 2021. Further, over 70 per cent of the urban population resides in the estimated five hundred class I cities (those with a population of 1,00,000 or above), even though the number of statutory towns was 4,041 (2011) and the number of urban areas (including Census towns) being 7,936.

It was only in the mid-1980s, through the National Commission on Urbanization (1986-1988) that urban areas were accorded some sense of priority in terms of being 'engines of growth' – a term that has persisted to this date. In 1991, the Rakesh Mohan Committee emphasized the need for mass scale investment into urban infrastructure. A slew of programmes followed – notably the Mega Cities Scheme, the Accelerated Urban Water Supply & Sanitation Programme, the Integrated Development of Small and Medium Towns – but with a piecemeal and on-the-fly approach to projects coupled with a rather small budget, these schemes failed to make much impact. In fact, one of the earlier international cooperation projects with United States Agency for International Development attempted to identify and address the reasons why local self-Governments were so woefully under capacitated to carry out large scale infrastructure development – the result of which was the identification of a wide range of reforms that Government of India has been pursuing to take up with States. However – it was clear that unless there was no targeted expenditure in urban infrastructure and cities in general, the economic and human potential of India would never be fully utilized.

It was in 2005 that the first of these programmes emerged in the form of the erstwhile Jawaharlal Nehru National Urban Renewal Mission (JNNURM) – that focused on development of infrastructure within cities as well as provision of housing and other basic services (known at the time as the 'seven-point-charter'). For the first time, a National level programme with a significant budgetary allocation at the National level, a commitment of meeting a portion of the costs from local self-Governments and/or State Governments and a portion of funding contingent upon implementation of certain reforms was taken up. However, there were issues in the design of the programme – notably the centralization of all approval processes – that led to considerable impediments as regards what was originally expected of the programme.

It was after 2015, under the new dispensation – where the lessons learnt from JNNURM and its allied programmes was revisited – clearly indicating:
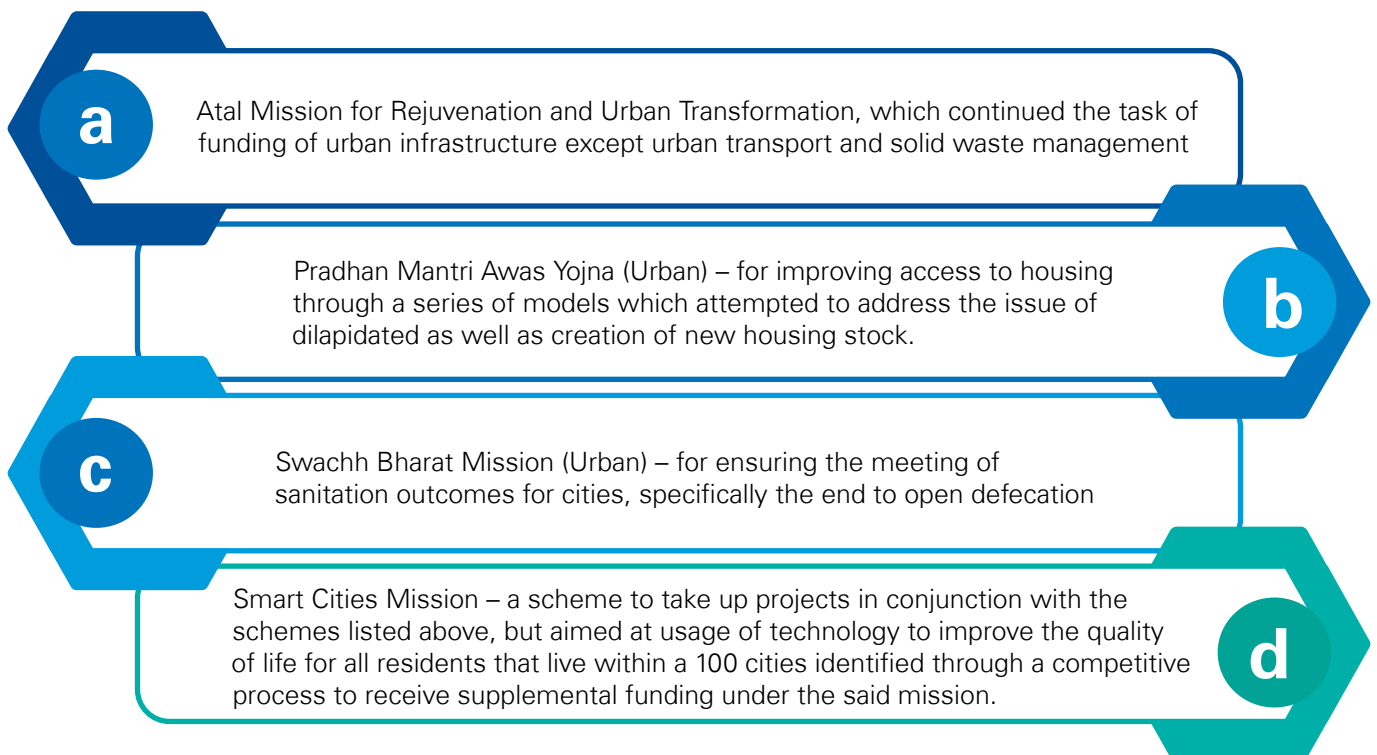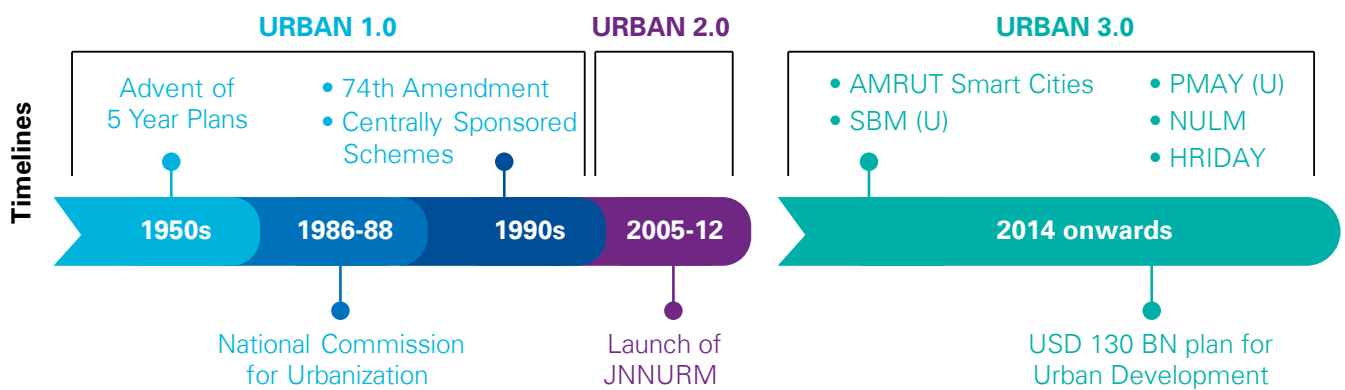
- the continued need for extending Central funding to urban infrastructure
- the need to improve accessibility to housing
- the need to invest heavily into the last mile for achieving health outcomes in sanitation, and

the city as a complex microcosm of systems – and the level to which it could being in improved efficiency, transparency and accountability through the engagement of 'smart' systems

It is this understanding that has largely led to the current (and ongoing) generation of urban development programmes – notably:

Citizen-centric smart city design

Tracing India's Urban Journey Post Independence

a Atal Mission for Rejuvenation and Urban Transformation, which continued the task of funding of urban infrastructure except urban transport and solid waste management

b Pradhan Mantri Awas Yojna (Urban) – for improving access to housing through a series of models which attempted to address the issue of dilapidated as well as creation of new housing stock.

c Swachh Bharat Mission (Urban) – for ensuring the meeting of sanitation outcomes for cities, specifically the end to open defecation

d Smart Cities Mission – a scheme to take up projects in conjunction with the schemes listed above, but aimed at usage of technology to improve the quality of life for all residents that live within a 100 cities identified through a competitive process to receive supplemental funding under the said mission.

The Smart Cities Mission – in a true sense – could be called India's first outcome driven urban development programme that does not focus on the creation of any one specific kind of asset – but on a wide range of projects that 'add to' the normative assets to make them particularly usable for the people. A number of performance areas – about 16 in number - were identified for Smart Cities – which have, through the course of the last four to five years – yielded a mixed variety of results. Notable amongst them was the use

of a new institutional mechanism for implementation of the Smart Cities Mission.

How this document is structured

The lessons learnt during the last four years include findings from not only Smart Cities Mission, but also the other Centrally sponsored schemes. This paper attempts to trace the evolution of some of the sectors that have been covered under the Mission as well as its allied schemes, along with findings and lessons learnt.

Early in the evolution of Smart Cities, it was generally agreed by most countries that city-wide connectivity will play a significant role in the development of smart cities – further buttressed by the projection that by 2025, over 25 billion[1] devices would be connected to the ' Internet of Things' or 'IoT' – as it is commonly known. In India too, this realization has dawned early onwards in the cities designated to receive funding within the scheme – as is evident with the presence of Integrated Command and Control Centers in literally each of the designated cities. However, for all the reliance on technology – connectivity options in many cities identified to receive funding under the Mission remain a challenge. With India having very successfully rolled out 4G cellular (LTE or Long Term Evolution) connectivity across the country, it is now proposed to commence roll-out of 5G services – widely seen as an answer to the lack of connectivity options within the Smart City Mission fund recipients over longer periods. The first chapter – therefore, deals with the matter of connectivity – lessons learnt over the last four years and what to expect or anticipate when the 5G services roll-out.lessons learnt over the last four years and what to expect or anticipate when the 5G services roll-out.

A key concern that arose early in the evolution of Smart Cities is the level of engagement of the people in conceiving these smart cities and the ability of the smart city to reclaim spaces for its people. Across the world, the phenomenon of 'smart cities' has generally implied improving equitable access to services, opportunities and increased accountability of public representatives and officials. Much of these concerns have arisen over the mixed outcomes from implementation of e-Governance services, a model as old as the earliest urban development programmes in India. For the most part, routine works such as issuance of birth and death certificates is now generally automated, but more complex functions – such as participatory budgeting, citizen participation in determination of priority projects, actively determining the proposed design features or functionalities of public governance systems have largely stayed out of the reach of the common person. In some cases, the advent of technology such as social media – while removing the boundaries between proximal and distal, have also led to erosion of traditional forums of accountability such as ward Committees, *mohalla samitis* and other such forums where elected representatives could interact with the public at large. By design, the Smart Cities Mission is expected to concentrate the maximum amount of funds and efforts to a predesignated, identified area of the city – usually no more than 10 to 15 per cent of the city's administrative area (and also as less as 2 per cent in some cases), therefore instances of inclusion and reclamation of public spaces are usually to be found within that area. For the remainder of the city, city wide information and IT systems were expected to bridge the gap between accessibility & accountability. The second chapter deals with issues of whether the Smart Cities Mission has led to cities having become more accessible and accountable and whether they have led to citizens reclaiming the public space for governance.

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1.   Gartner Research, 2018, Smart Cities World Expo Congress, Barcelona

The Smart Cities Mission provisions a sum of INR 1,000 crore (contributed by the Government of India as well as the State Government/ UT Administration on a 50:50 basis).This amount, by itself is not adequate to create a 'transformational' effect within a city. Alongside the Mission funds, it was also expected that these Smart Cities would use these funds in conjunction with the allied schemes – usually to the extent of another INR 300 to 400 crore – and the rest leveraged by way of borrowings and private sector participation in the form of public private partnerships or privately financed infrastructure. While on an average, a non-State capital city Smart City plan outlay has varied between INR 1,500 to 2,500 crore, in some cases, cities have also laid out budgets as large as over INR 4,000 crore. Given the reducing trend in municipal revenues as a share of GDP and reducing share of own source revenue to gross receipts by way of devolution, a fair question to ask is whether these targets are realistic or not. The third chapter deals with the lessons learnt in financing in India, as well as how some international models – notably the Economic Investment Vehicle as used in the United Kingdom hold a key to financing future projects in India with respect to Smart Cities.

While a large number of projects related to technology and creation of physical infrastructure adorn the Smart City plans, the provision of affordable housing remains a challenge for cities and States in general. The working group on estimation of housing shortage, at the onset of the 12th (and last) Five Year Plan had estimated a shortage of 18.78 million housing units in urban areas, including dilapidated/ unfit for habitation stock, congestion and units not constructed. About 95 per cent of this shortfall lay in the segment of economically weaker sections (i.e. with household income less than INR 3,00,000 per annum) and low income group (i.e. with household income less than INR 6,00,000 per annum) The Pradhan Mantri Awas Yojna (Housing for All – Urban) has attempted to alleviate this shortfall to a large extent, but whether this has led to a dependency on direct subsidies and patronage of Government housing or has promoted affordable housing as a viable industry – is the focus of the fourth chapter in this publication. Furthermore, in line with the recommendations of the Kelkar Committee, many State enterprises including local self-Governments have been exploring the options of monetizing lands held by them or vested with them. The chapter also explores these options as well as lessons learnt in the process – and whether there is or should be a standard way of monetization or not.

Water supply & sanitation have probably comprised the single largest component for all urban development programmes – almost to the extent of being synonymous with municipal infrastructure in most countries – including India. Right from the earliest days of investing into urban development in India, access to safe & clean drinking water supply has been a primary concern of communities and their local representatives. While most service level declarations in cities now quote a coverage of over 90 per cent in terms of supply, the number of hours of supply are often few and fragmented. Some cities have attempted to create 24x7 systems for water supply, but adoption remains low – despite there being ample evidence that such systems do not necessarily consume more water, and that such systems can be significantly more efficient than conventional water supply systems – coupled with the appropriate reforms. Likewise, sanitation – for a long time – remained synonymous with having a hygienic water closet within the confines of one's own home or within the community. The Swachh Bharat Mission – Urban has been successful to the extent of ensuring the elimination of open defecation by almost 99 per cent[2] in urban areas. However, with the emerging mantra of resource recovery and circular economy, a more holistic look at sanitation – notably the issue of waste management – appears to be necessary. The fifth chapter deals with the lessons learnt during water and sanitation programmes taken up during the course of the last four years and what could be done to make sure that the sector meets with the outcomes of the Sustainable Development Goals by 2031.

2. Ministry of Housing & Urban Affairs, Government of India, August 2019
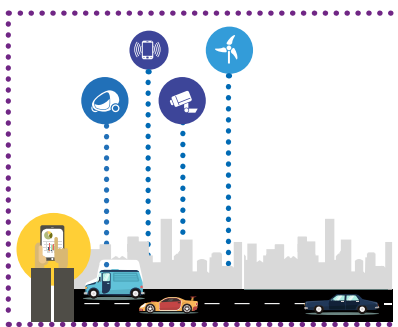
The sixth chapter discusses the emerging trends of mobility within urban areas. In India, as with many emerging economies, investments into public transport has been lower than most developed nations and means of personal transport retain an 'aspirational' edge over public transport. As a result, not only are roads in Indian cities and towns more congested and disorganized than developed countries, there is also the element of environmental degradation from vehicular pollution – now officially deemed responsible for poor air quality in many cities. Over the last several years, adoption of electric vehicles and mobility has gained traction – but remains prohibitively high on account of high entry costs and the paucity of appropriate infrastructure for charging of the same. This chapter also attempts to throw some light over these aspects and how examples from other cities and countries could help.
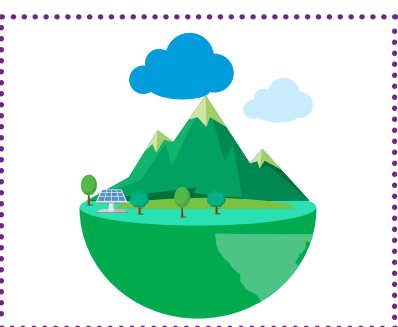
The seventh chapter addresses the issue of the urban environment in general. Many cities are now waking up to the issue of energy consumption and carbon footprint, with the Smart Cities Mission seeking to ensure that at least 10 per cent of the city's energy requirement is met through non-conventional, renewable & clean energy – notably solar and/or wind. The urban environment, in general also has a significant bearing on health outcomes of its residents. Recent experience would indicate that poor layout and planning of open spaces and built volumes, improper usage of materials etc. lead to direct as well as indirect instances of overuse of energy, which in turn disturbs the ecology and also exposes the city to instances of heatwaves, shortage of water etc. – some of which have traditionally not been considered disaster events, but are now officially regarded so in planning lexicon. Poor planning also leaves cities vulnerable to instances of loss of life and property on account of more conventional disaster events such as floods, earthquakes, as well as impeding its ability to be resilient to such events. This chapter discusses some of the lessons learnt in the recent times as regards what to avoid and what to do when faced with such risks, or rather, keeping such risks minimal in the first place.
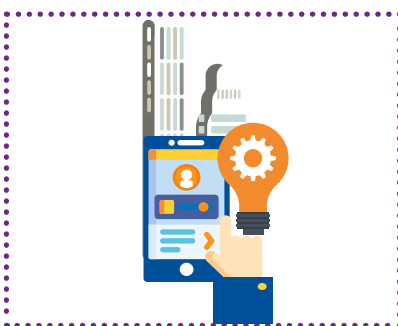
The eighth and final chapter discusses the issues faced in implementation of projects within cities designated to receive funding under smart cities. Some of these have been institutional, others on design and many on account of poor planning and/or structuring of projects. This chapter identifies some of the key bottlenecks that have been typical of the projects and their operating structures. It is aimed to draw some lessons for future instances of smart cities – as is believed to be under consideration by the Government of India as well as the State Governments.

Finally – this paper hopes to serve as a set of insights into the longer term nature of urbanization in India to help the various stakeholders to introspect and prepare for the next and future generations of inclusive urban development programmes in India.

1 Connectivity options for smart cities

> **Once a new technology rolls over you, if you're not part of the steamroller, you're part of the road.**
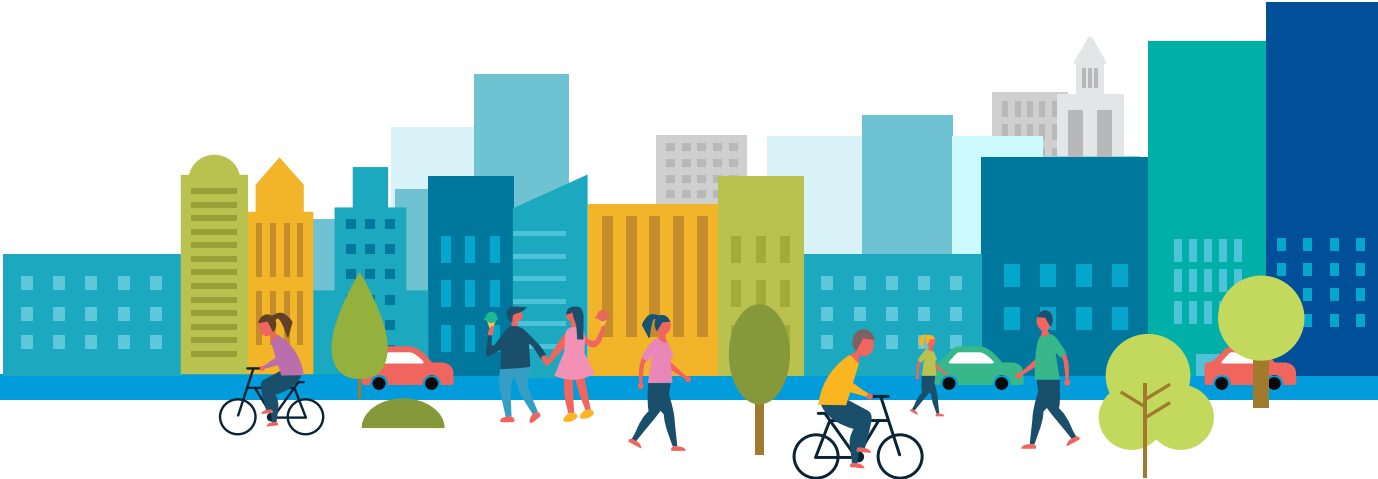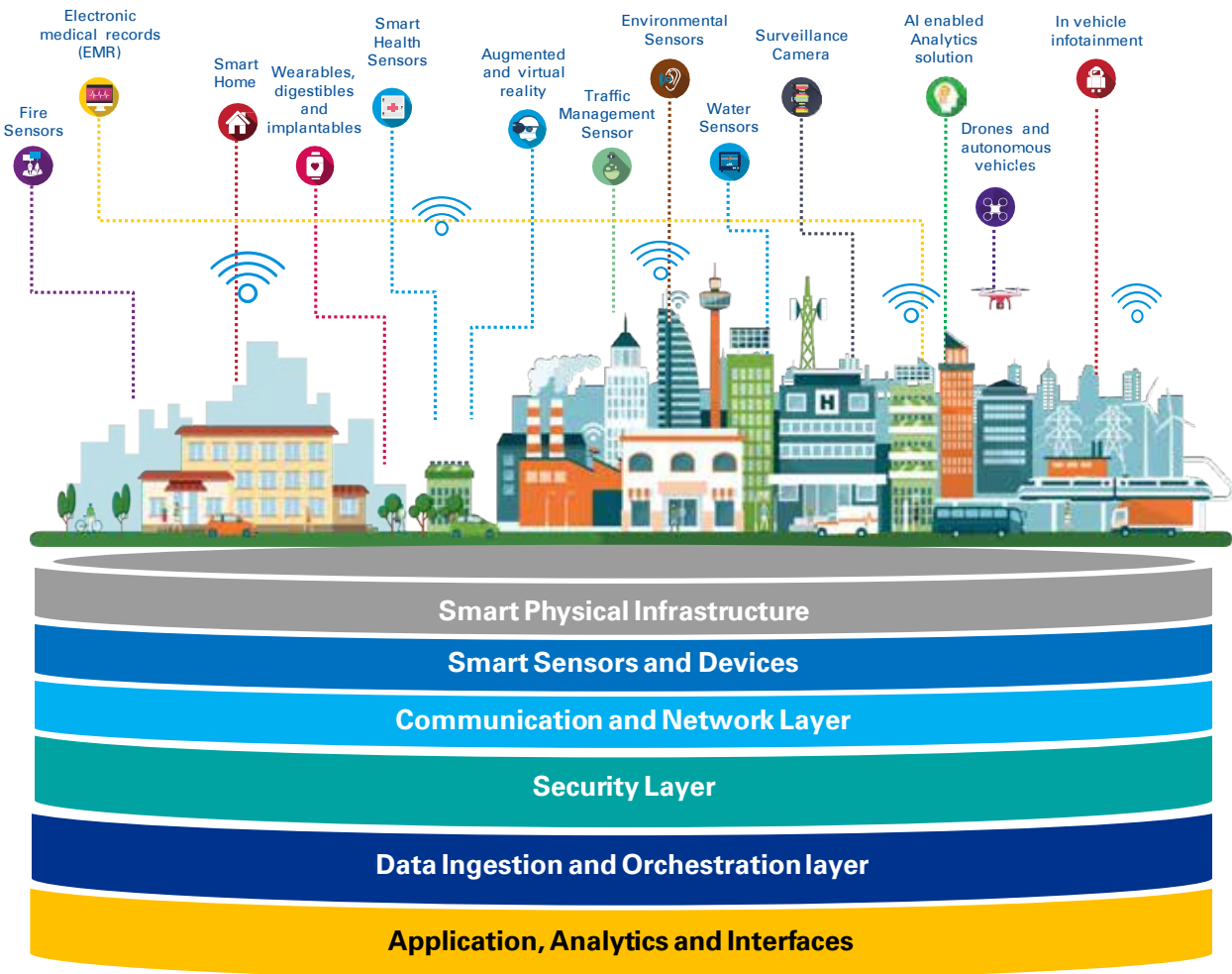>
> **Stewart Brand**

Background

As cities strive to deliver better services by efficient management of resources, infrastructure, greener environment and smart governance, smarter and timely decisions are vital. Hence cities rely on real-time/ near real-time data generated from multiple sources, sensors, IoT devices etc. Connectivity is the foundation layer for any Smart City, the core concept of a smart city would not be possible without ubiquitous connectivity solutions. The Wireline and wireless communications networks connect smart IoT devices, edge devices and sensors that supply any form of data i.e. video, text, data, image, or any other digital objects from a local area network (LAN) to wide area network (WAN) from which information is derived to manage assets and resources efficiently.

The Information and Communication Technology (ICT) architecture of a smart city has six layers: Smart Physical Infrastructure, Sensors and Devices, Communications and Connectivity Networks, Security and Privacy, Data Ingestion and Orchestration & Applications, Analytics and Interfaces. These can be organized in a layered Smart City Stack[2] framework, as illustrated below, which shows the importance of Connectivity and Communication in building smart cities by connecting the applications/services layer and the city infrastructures, such as electricity grid, roads, parking.

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1. Smart City Transformation in a post-COVID world, KPMG (2020)

Fire Sensors

Electronic medical records (EMR)

Smart Home

Wearables, digestibles and implantables

Smart Health Sensors

Augmented and virtual reality

Traffic Management Sensor

Environmental Sensors

Water Sensors

Surveillance Camera

AI enabled Analytics solution

Drones and autonomous vehicles

In vehicle infotainment

Smart Physical Infrastructure

Smart Sensors and Devices

Communication and Network Layer

Security Layer

Data Ingestion and Orchestration layer

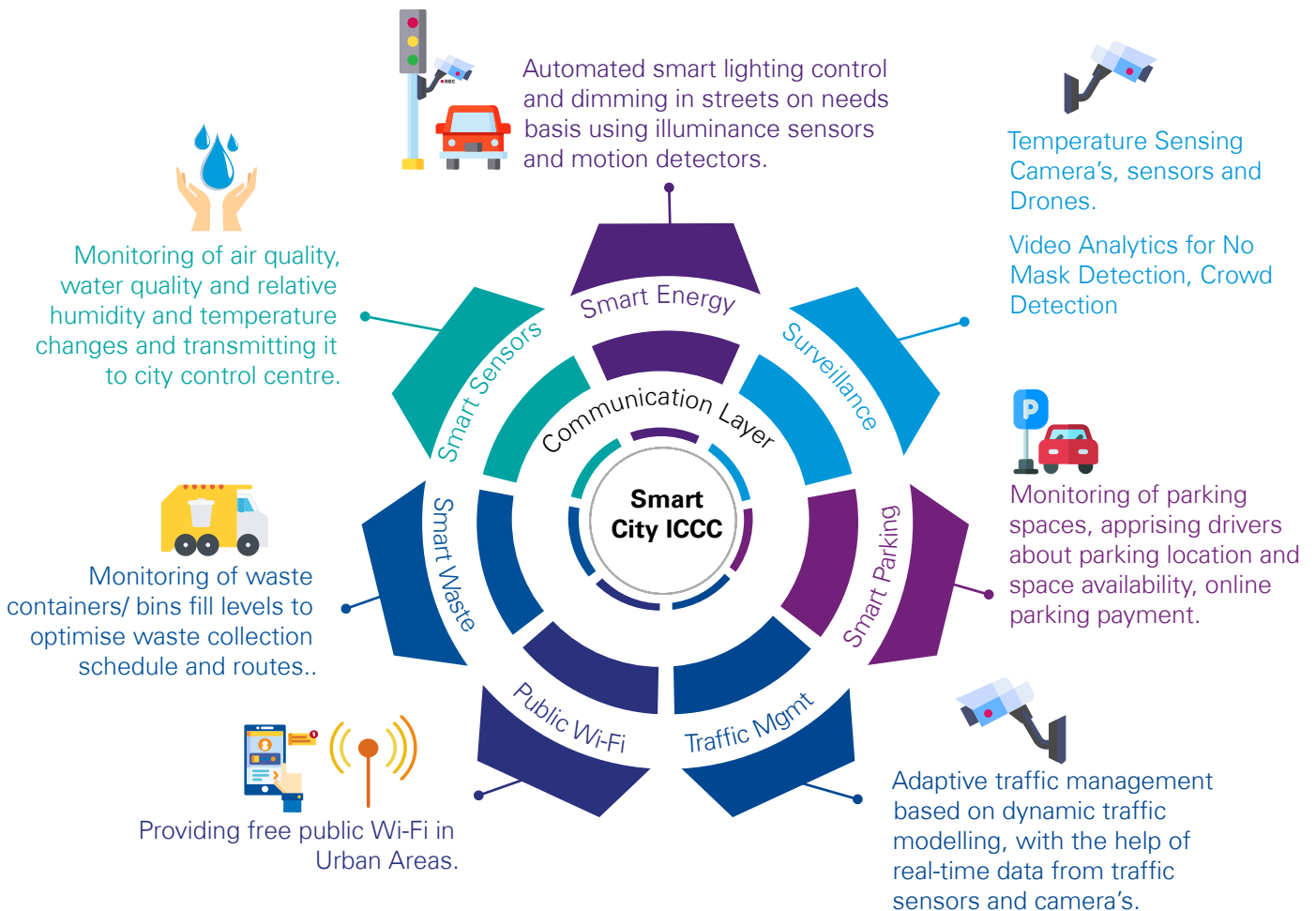**Application, Analytics and Interfaces**

Though smart cities are emphasizing on the Data Ingestion and Orchestration & Applications, Analytics and Interfaces, some of the important smart city work currently being implemented is to solve issues of data security, data integration, privacy, standardization, APIs, and monetization. While recognizing the significance of data, cities need to also focus on the communication networks layer. In fact, the layer of communication networks is City's digital nervous system, the main vehicle of information and the core framework to model how applications and services can communicate over one or multiple networks. It is important to note that cities should not simply rely on Communications and Connectivity Networks decisions on the network operators and system integrators which develop a system that satisfies the current needs and technical specifications but also should target integration with sensors, edge devices, cameras and IoT devices installed in Smart homes, Smart Campuses and Smart factories.

Requirements of connectivity in a Smart City

In order to various citizen services, cities deploy several smart applications that rely on wired/wireless connectivity:

Automated smart lighting control and dimming in streets on needs basis using illuminance sensors and motion detectors.

Temperature Sensing Camera's, sensors and Drones.

Video Analytics for No Mask Detection, Crowd Detection

Monitoring of air quality, water quality and relative humidity and temperature changes and transmitting it to city control centre.

Monitoring of parking spaces, apprising drivers about parking location and space availability, online parking payment.

Monitoring of waste containers/ bins fill levels to optimise waste collection schedule and routes..

Providing free public Wi-Fi in Urban Areas.

Adaptive traffic management based on dynamic traffic modelling, with the help of real-time data from traffic sensors and camera's.

Connectivity requirements in Smart Solution deployed in India

A wide variety of connectivity solutions are already available in the Smart cities in India. The solutions vary in their technical specifications, which determine the specific Smart Solution use cases that can be served by any particular connectivity solution in particular region or geography. Some of these factors are:

- Data throughput
- Latency
- Battery life
- Frequency
- Capital and recurring costs
- Maximum data range

- Coverage
- Security
- Scalability
- Robustness
- Mobility

2.   Smart Cities in India: Framework for ICT Infrastructure- White Paper by TRAI

Smart City Connectivity solutions can be divided into two main categories: wireless and wired connectivity solutions. The wireless solutions can be divided into long-range and short-range connectivity standards. Long ranges go up to 200km, whereas short-range solutions cover a maximum of approximately 100m (Bluetooth® low energy). Long-range connectivity solutions can then be further subdivided into licensed (cellular) and unlicensed standards, known as LPWAN (Low Power Wide Area Networks).

The most used connectivity solution in Smart Cities are fiber, cellular (2G/3G) and Wi-Fi . Though these solutions offer high bandwidth, the main drawbacks are high energy consumption, high capital or recurring expenditure for network roll-out, approvals for right of way, longer deployment time and public inconvenience.

A snapshot of popular wireless technologies available is given below:

Short Range	• IEEE 802.15.4 (ZigBee, 6LoWPAN…), Bluetooth/BLE, Z-Wave, IEEE 802.11ad (WiGig)
Medium Range	• Wi-Fi, IEEE 802.11ah (Wi-Fi HaLo), IEEE 802.11p (vehicular transmission systems).
Long Range	• LoRa / LoRaWAN, SigFox ™, DASH-7 etc. , Cellular: 2G-GSM / GPRS, 3G, NB-IoT, LTE-M, 4G, & 5G.

Some of the connectivity technologies are based on cellular networks and use licensed spectrum (LTEM, NB-IoT, 2G, 3G, 4G, 5G) that can only be deployed by Mobile Network Operators (MNOs). In India, two bands[2], 2.4 GHz (2.400–2.4835 GHz) and 5.8 GHz (5.8255.875 GHz), have earlier been defined as License-exempt bands for indoor and outdoor applications. In addition, now 5.15–5.35 GHz, 5.470–5.725 GHz, and 5.725–5.875 GHz are also available for indoor and outdoor uses in unlicensed bands. In sub-GHz band 433–434 MHz and 865–867 MHz are license exempt for indoor applications.

The selection of connectivity technology depends on the envisaged application. For critical applications like city surveillance, traffic enforcement etc., quality of service (QoS), security, reliability and latency are the key criteria for deciding a communication technology. For non-critical applications such as environmental sensors, smart meters, ease of deployment and operating and maintenance costs are the key criteria.

The use case wise bandwidth requirement, connectivity technology used, and alternate options are given below:

Application	Bandwidth Allocation (Estimates)	Number of Installations/ Devices/Sensors	Technology Used (commonly)	Alternate Technologies which can used
City Surveillance	High definition: 4-5 Mbps/camera	250-350 Cameras	Wired Connectivity. Under Ground OFC	4G/ Wi-Fi/ 5G
Adaptive Traffic Controller System	Few Kilobytes	15-30 Junctions	Wired Connectivity. Under Ground OFC	GSM/4G
Environmental Sensor	Few kilobytes	10-15	Wireless (GSM Sims)	LoraWan, Sigfox
Smart Lights	Few kilobytes	10000-15000	Wireless (GSM Sims, Zigbee, Wi-Fi)	LoraWan, Sigfox
Traffic Enforcement	High definition: 4-5 Mbps/camera	6-8 Cameras per junction	Wired Connectivity. Under Ground OFC	4G/ Wi-Fi/ 5G
Public Wi-Fi	50-100 Mbps/access point	15-20 Access points	Wired Connectivity. Under Ground OFC	mmWave
Parking Sensors and Billing	Few kilobytes	15-20 Sensors in parking location	Wired Connectivity.	LoraWan, Sigfox

One of globally popular connectivity options in smart cities is the Low-power wide-area networks. LPWAN addresses most of the connectivity requirements of smart ecosystems, offer broad coverage while the power consumption is also minimum. One advantages of LPWAN is the prolonged battery life, the devices can be placed in low energy sleep mode and activating only when they need to communicate with the gateway for e.g. Disaster monitoring sensors for Forest Fires. This reduces the total cost of ownership since a low volume of data is consumed, reducing operating and maintenance costs. Application areas for LPWAN: Stationary applications, non-real time applications and battery-operated devices/sensors which require high battery life.

Few case studies are given below:

City	ICT based smart solution with LoRA
Buenos Aires[3]	The city is using LoRaWAN to monitor energy consumption, water level in reservoirs and water flow, environmental sensors and smart lighting.
Ludhiana[4]	The city has deployed a high number of parking sensors for parking enforcement
Zurich[5]	The city is using LoRa based network for abandoned bike detection and recovery, detection of power distribution grid failure and real time occupancy in public transport
Amsterdam[6]	The city is using ICT based solution to monitor and manage the parking

Impact of 5G in connectivity solution in smart cities

India definitely has a play in-terms of having enough business use cases, available prototypes and collaborative environment to make 5G both profitable and sustainable on a large scale especially in Smart Cities. The enabling aspects of 5G are:

Few case studies are given below:

Ultra-reliable and low latency wireless communications (URLLC): 5G ultra-reliable connectivity and low latency will provide users the ability to perform remote operations; e.g. it enhances the ability of factory automation, enable safer autonomous driving, doctors can perform remote surgeries etc.

Massive machine type communications (MMTC)[7]: 5G enables a massive number of low-cost, seamlessly connected, low-energy devices, like the Internet of Things (IoT), to share data as they are deployed to your secure 5G network.

Enhanced mobile broadband (eMBB): 5G would provide high throughput experience, cater to densely populated cities/ urban area's and would enable use cases like City surveillance, artificial intelligence, mixed reality, Augmented/ Virtual reality and drone-based applications.

Massive connectivity
Support 1M simultaneous device connections within a .5 mile radius

High Speed
Download 15GB HD video in 6 seconds 4K Viewing, AR/VR application

Better Battery Life
Extended battery life of devices upto 10 times

Ultra Low Latency
Enable wireless connectivity for City Surveillance, Traffic Enforcement

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3. Signalsiot. Ciudad de Buenos Aires Utilizará IoT Para Monitorear Diferentes Variables en 40 Escuelas. 2019.
4. IoT in India Advances Business Digitalisation in India, Ali Hosseini, CEO/Director, SenRa, Sunil David, Regional Director - IOT (India and ASEAN region), AT&T; Monika Gupta, Vice President, Capgemini, 2019
5. Secure Position Data Transmission for Object Tracking using LoRaWAN, Matthias Diez, University of Zurich, 2017
6. Reclaiming public space: Amsterdam's smart parking solutions, https://www.iamsterdam.com/en/business/key-sectors/smart-mobility/insights/amsterdam-smart-parking-solutions
7. Now is the time to answer the 5G call (KPMG, 2019)

Recommendations

The applications layer of smart cities consists of several applications, where each application has its own connectivity requirement and expectation. Hence planning of connectivity solutions should involve different technologies depending on the application and the deployment environment. Though Wired technologies have been the most desired solution so far however wireless technologies like LPWAN, 5 G can bring a lot of flexibility, scalability, cost efficiency and ease of deployment. Hence our recommendation to the City administrators is as follows:

01 Plan for Hybrid network

The networks in cities have been built traditionally by Telecom Service Providers (TSPs), Internet Service Providers (ISPs), cable operators etc. which are normally extended for smart cities may not be the optimized/smart solution. Since most of the smart solutions deployed in Smart cities support wireless technology while planning the network wireless technologies which require lower power, should be considered.

02 Supporting network sharing infrastructure models that promote competition and network coverage and extension

This can be achieved by providing support to various industry initiatives which can build on TSP/ISP infrastructure sharing agreements.

03 Stimulating demand and new use cases through the LPWAN, 5G etc. PoCs and Trial Programme

A series of pilot projects should be funded by the Smart cities to explore different connectivity solutions and business models.

04 Plan for connecting all the devices

Presently smart cities are only targeting data from devices, sensors owned by cities, Government departments. The reach should be extended to target integration with sensors, edge devices, camera's and IoT devices installed in Smart homes, smart campuses and smart factories.

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Director,
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2 Citizen centric design for smart cities

Taking cue from global assessments and indices covering large transformative programs a Citizen-first approach is being administered in the recent past. To date, considering citizens' perceptions about and perspectives of smart city development is seen as a sound strategy for many political and administrative leaders. Particularly, this has taken the form of promoting e-Governance (citizen centricity in e-government) and is rooted in the perspective of "citizens as customers" under the new public management. Based on this influence, apart from technological needs or smart cities, in recent years, city administrators have shifted their focus to co-creating smart cities with their citizens. For example the UN E-government Development study follows an outcome-driven methodology using an Outcome Transformation Measurement (OTM) which is considered as a composite index that assesses Government Transformation, Business Transformation and Citizen Transformation. Digital e-Governance has been an integral part of India's agenda to build transparency and empowering its citizens through various service offerings. Lately, the use of information and communications technology has been infused into all development initiatives across the globe as it has a great potential to accelerate economic growth of a country. However, to achieve a successful e-Governance system it is necessary to introduce digital interactions between a citizen and government, between government and businesses, between government and its employees etc. in order to function in a seamless manner. In its pursuit to achieve excellence in e-Governance for the benefit of citizens, the Government of India has embarked upon this journey to facilitate digitization and transformation in direct service delivery and citizen engagement. When it comes to the "Smart City" development agenda, synergy between the digital and human facets ("Citizen-centric") are also very important to grow the economy and to foster comprehensive institutional, social, physical and economic infrastructure development of cities.

> Creating the strategic framework and guiding principles with a 'citizen centric' view is a key foundational component of Smart City thinking.

Putting people first helps to ensure that the real needs of the community are being addressed, rather than succumbing to the allure of making a city SMART. Not only does it focus on the real 'why' of embedding Smart City thinking, the various stakeholders become an integral part of the solution, with a sense of ownership and stewardship of the process. Smart Cities can better realise their potential when they encourage a diversity of players to participate and collaborate especially the Citizens itself. Such collaboration is important right from the beginning – at the point when a city looks to develop its Smart City strategy and roadmap. A platform that enables stakeholders across government, business, universities, start-ups and citizens to experiment and interoperate is at the heart of a successful Smart City ecosystem.

At the heart of true Smart City success is a fundamental mind-set shift, embedding Smart principles, and technology along with a Citizen interaction layer within the very fabric of a City's operating model. For existing and Smart Cities of the future these techniques should be incorporated by default to solve public problems and improve livability. Getting to that point will take time, however, as Cities deal with legacy structures, policies,

risk profiles and of course the challenges of managing current business-as-usual. There are a number of foundational elements that Cities should consider, as they move along this journey. India has taken full cognizance of the need to have both 'second-in-line' or 'smart cities' and even made great stride towards the same[1]. However, the aspect of citizen centricity must be further intertwined with the efforts made. While the Smart cities in the country are at various levels of "smartness" governed by the adoption and usage of digital technologies by citizens, citizen responsiveness is not captured in the complete sense. And this is easily evident, by observing the initial advents in this domain, leading to the first-ever planned city of Chandigarh. And then, cutting to the more recent attempts of creating Lavasa and even Amaravati. While all these were good attempts initiated with a focus on addressing citizen requirements, somewhere down the line, the tenets of 'ease of living' and 'citizen friendliness' etc. need to be strengthened. To ensure greater public participation, like in other parts of the world , there is a need to bring in the element of citizen-centric system. The entire framework is to be revisited to make Smart city governance more citizen engaging and participative.

Three layers of "smartness":

Adoption and usage, often leading to better decisions and behavior change

← Smart applications and data analysis capabilities

← The tech base includes networks of connected devices and sensors

← Traditional infrastructure (physical and social)

Source: KPMG in India report on Smart sustainable cities is a journey. Not a final destination prepared for World Engineering Day for Sustainable Development, 2020

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Sustainable development is the pathway to the future we want for all. It offers a framework to generate economic growth, achieve social justice, exercise environmental stewardship and strengthen governance

Ban Ki-moon

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1. Smart Cities Mission, 2015

Additionally, some recent global studies have revealed that Smart City Standards and Frameworks used by countries have an explicit citizenship rationale for guiding the standards and development of a smart city, although these guidelines are in an evolving stage[2].

While new technologies, talent, collaboration and open data are all key to expanding smart city capabilities out to a broader audience, the most important thing is to focus on the amenities offered to citizens rather than on building urban infrastructure and facilities. A key fundamental point is that what they are developing shouldn't just be smart for smart's sake. It has to deliver a benefit to the citizens of a city. Whether it drives better quality of life, economic efficiency, better health outcomes — there must be a societal benefit.

> The most important aspect is to focus on the amenities offered to citizens rather than on building

Citizen-centric Smart City design

Smart City
Urban Infrastructure

Security
- Predictive policing
- Real-time crime mapping
- Gunshot detection
- Smart surveillance
- Emergency response
- Body-worn cameras
- Disaster early-warning systems
- Personal alert
- Home security

Economic development
- Digital business licensing and permitting
- Digital tax filing
- Online retraining programs
- Personalized education
- Local e-career center
- Digital land-use and building permitting
- Open cadastral database

Healthcare
- Telemedicine
- Remote patient monitoring
- Lifestyle wearables
- First aid alert
- Real-time air quality information
- Infectious disease surveillance
- Data-based population health interventions
- Integrated patient flow management systems

Mobility
- Real-time public transit information
- Digital payment in public transit
- Predictive maintenance of transport system
- Intelligent traffic signals
- Demand-based micro transit
- Smart parking
- Car sharing
- Bike sharing
- Integrated multi-modal information
- Real-time road navigation

Energy
- Building automation
- Home energy automation and tracking
- Smart lights
- Dynamic electricity pricing
- Distribution automation

Community
- Local citizen engagement
- Local connection platforms
- Digital administrative citizen services

Water
- Water consumption/ quality tracking
- Leakage detection
- Smart irrigation

Waste
- Digital tracking/ payment for waste disposal
- Route optimization

Interaction Layer – Service Delivery Platform, Integrated Operations Center etc.

Internet of Things

Source: KPMG in India Analysis based on market research 2021; KPMG report on Smart sustainable cities is a journey. Not a final destination prepared for World Engineering Day for Sustainable Development, 2020

2.   Social Inclusion Indicators for Building Citizen-Centric Smart Cities: A Systematic Literature Review, Jalaluddin Abdul Malek, Seng Boon Lim, and Tan Yigitcanlar, 2021

Citizen-Centric Smart City
Citizen-focussed Amenities

Embedding Citizen-first approach

Physical infrastructure
- Real estate
- Affordable and variety of housing options
- Multi-modal Transportation System
- Clean energy sources
- Access to electricity
- Reduced commute times

Social infrastructure
- Culture & Tourism
- Local Language Adaptation
- Religious buildings
- Low Crime Rate & High Safety
- e-service delivery & e-governance
- Grievance Redressal Mechanism
- Social security for unemployed, senior citizens etc.
- Alternate/tele-commuting opportunities
- Income Parity

Essential services
- Clean drinking water
- Sanitation facilities
- Parks and green zones
- Banking and Financial institutions
- Areas of recreation
- Hospitals, clinics, pharmacies and other institutions of health service delivery
- Waste Recycling
- Waste disposal

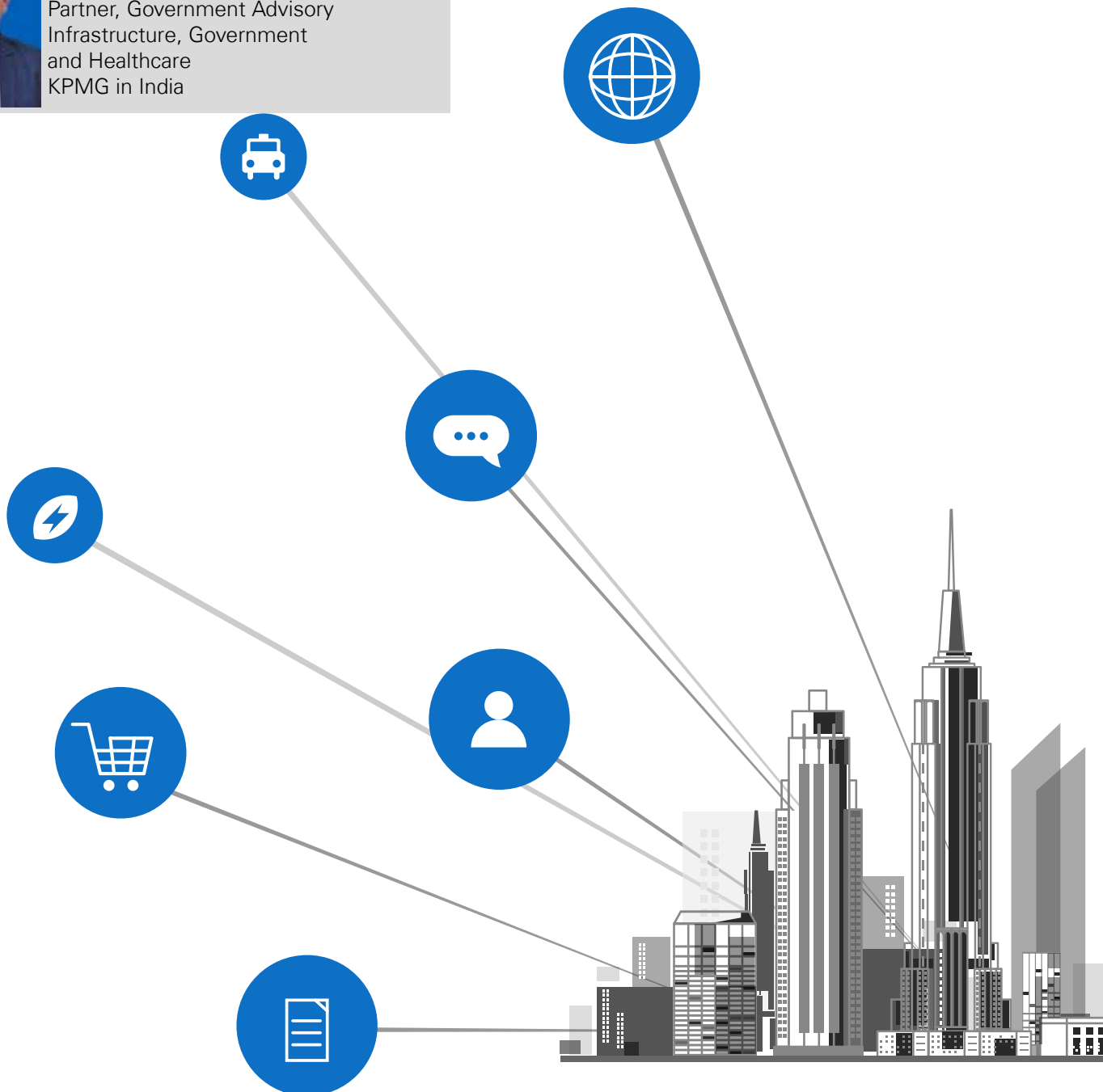### Citizen Participation (Participatory eGovernance)

Citizenship Responsibilities

It is interesting to note that all these areas encompass within themselves parameters that revolve around the earlier mentioned thrust points of 'citizen friendliness' and 'ease of living'. India requires 'cities of the future' to be carefully developed around the needs of its 1.3 billion strong population. And incorporate the needs of both resident and floating citizens, which is where, the citizen-focussed amenities spanning across Physical Infrastructure, Social Infrastructure and Essential Services mentioned above, need more focus now than ever before. These 3 areas enfold parameters that revolve around 'Quality of Living' and 'Livability'. This is also aligned with the Global City Indicators Program, that recommends and then tracks & measures key City Statistical Indicators.

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For upcoming tier II and III cities, semi-urban and rural areas into "Smart Cities", the seepage of the Digital India Mission must be seen in congruence with the Smart Cities Mission. Especially with the learnings from the COVID-19 pandemic, it is evident that a high population density will bring no advantages to any of the stakeholders involved, going forward. The time is right to understand that with the political, social and economic sphere becoming increasingly reliant on digital channels, the ideology of embedding citizen centricity into the current smart city development model is to be looked into. Digitization and technology can help to an extent, but mindset and cultural changes are equally important, this is where a citizen-centric approach will come into play.

3 Smart investing in our cities

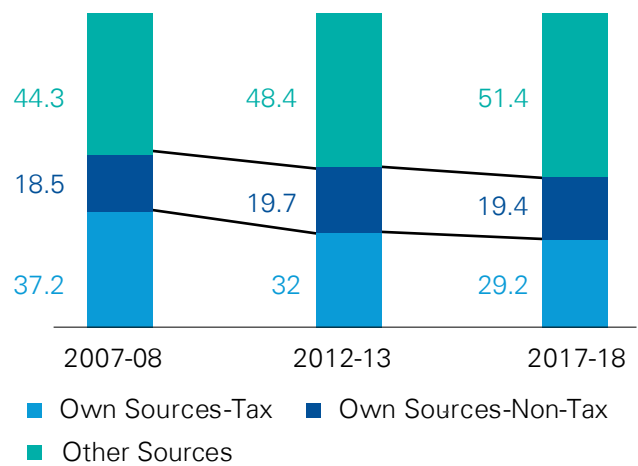**Delivering with Impact – The Economic Investment Vehicle**

Background

Conventionally, Housing and Urban Development have collectively accounted for a little over two per cent of the Plan outlay in almost every one of India's Five Year Plans till the Eighth Plan, which was spurred by the findings of the Rakesh Mohan Committee (1991) that India needed an annual investment of close to INR 28,000 crore into municipal infrastructure. The High Powered Expert Committee in 2011 estimates a need for INR 32.9 lakh crore as investment into urban infrastructure (at 2009-10 prices). Subsequent Finance Commissions have also recommended the need for increased devolution to States from the general divisible pool of Funds – which has been done so over the course of the last three Finance Commissions. At the current rate of allocation – both across State as well as Central Plan schemes, such schemes will be able to meet no more than half this requirement. The rest needs to be sourced by municipal States and municipal bodies themselves, whether from own sources, from debt or private investment. As of this time, looking at the state of affairs, this seems like a particularly tall order to fulfil.

This is on account of several factors – a key one being Municipal revenues being able to contribute less than one per cent of the National GDP, as opposed to 6% in comparable economies such as Brazil. This is both on account of the fact that India is far less urbanized than Brazil, as well as the fact that demand and recovery of municipal taxes and dues is significantly weaker. On an average, municipal revenues – including the largest municipal bodies that have a high revenue base, make up for only about half of the gross revenue receipts by design in any given year, and the continuance of unrecovered or written off arrears reduces this ratio even further. Recent years have shown a decreasing trend in own source revenues, thereby implying increasing dependency on Central and State Plan schemes.

Municipal Revenue by sources

	2007-08	2012-13	2017-18
Other Sources	44.3	48.4	51.4
Own Sources-Non-Tax	18.5	19.7	19.4
Own Sources-Tax	37.2	32	29.2

■ Own Sources-Tax   ■ Own Sources-Non-Tax
■ Other Sources

Source: Ministry of Housing & Urban Affairs. 2019

Why is this so?

While centrally sponsored schemes, along with State Plan funds have contributed to some of the fiscal shortages, most municipal bodies – especially the smaller ones (about 85% of all statutory towns) lack professional capabilities to develop, implement projects or manage services. As the impact of the Constitution of India (74th Amendment) Act, 1992 gradually caused State Governments to amend municipal laws, a large number of municipal bodies have found themselves assigned functions without being accorded appurtenant and commensurate workforce, skills or funds. As a result, even when monies from centrally sponsored schemes and State Plan funds do make it to the municipal fund for being utilized, contractors and other service providers charge a considerable premium to hedge against the risks created by inadequate capability of the municipality to manage projects and/or results.

Municipal powers for administrative, functional and technical sanction of expenditure are severely restricted by way of municipal finance & accounts rules, even when there is no liability to the State Fund. In certain cases, non-elected officials at the State level have higher powers of financial sanction as compared to the combined strength of the elected Council – a possible fall-out of the increasing dependency of municipal body on assigned revenues from the State.

While municipal bodies have been directed to seek and obtain credit rating, as of this time, very few municipal bodies – that too limited to the larger ones, show an investment grade rating. Municipal law in most States provide for a condition where settlement of debts may be done via 'interception', i.e. deducted pre-emptively by State Governments from the assigned revenue share for settlement of debt liabilities, as opposed to the municipal body itself creating a debt servicing/ reserve fund and servicing the debt from the same. This provision, and the manner in which it is used – has led to a lack of financial discipline, even when it comes to servicing debt. Most municipal bodies do not view debt as a desirable option for availing funds.

This problem of debt financing also divides itself into two aspects – that of financial credibility and robustness of the municipal body, which is reflected in its credit rating, and the financial credibility and robustness of the purpose, for which debt is sought. As discussed, municipal bodies – by themselves have limited credibility on debt servicing, as reflected by the credit ratings. However, the problem is exacerbated by the fact that the project(s) for which such debt is sought is/ are not entirely bankable either. This is reflected by way of the limited success that have been had with respect to PPP arrangements in municipal services – largely restricted to solid waste management (moderately successful), some instances of water supply (very limited success) and some instances of wastewater management/ faecal sludge management.

The India context - The infrastructure challenge

To achieve a GDP of USD 5 trillion by 2025, India plans to spend around USD1.4 trillion[1] on infrastructure over these years. As much as a quarter of this spending is expected to come from private investment. The public and private sectors need to work together to achieve this challenge and creating certainty and confidence in these opportunities, will be key, particularly in the wake of pandemic and the slowdown of the national and global economy.

Within this context, India is also one of the most rapidly urbanizing countries of the world. The most conservative assessments predict that over the next 15 years, nearly half of the country's population will be living in urban settlements. Creating sustainable and resilient urban infrastructure, sensible urban planning and providing essential public goods like clean water, transport, energy and sewerage are all vital imperatives for attaining India's Sustainable Development Goals and for providing inclusive, livable and a decent quality of living.

Given the nature of the need, significant public resources and energies have been focused on the urban sector, especially recently, with flagship Smart City Mission. While many of these programmes envisage significant private sector participation, there is an urgent need to ramp up private sector focus and spending on urban infrastructure and services, which focus on key projects.

Building a strong and viable investor supply side offer: Much more needs to be done around creating a sound and stable policy and regulatory environment which will enable Smart Investment into critical and prioritized projects. This includes designing a fair allocation of risks and rewards between government and the private sector, designing stable contracts, a quicker adjudication process, as well as the establishment of impactful instruments for providing finance to private investors.

Businesses are looking to India as a key emerging economy with opportunities for investment. This is demonstrated by India's ranking in the World Bank's ease of doing business index where India improved 14 places to 63 out of 190 countries in 2019[2].

Economic reform: Improving the ease of doing business as well as creating a transparent and enabling framework in India, which remains a strategic priority[3]. Against this backdrop, the economic investment vehicle (EIV) framework has been developed from leading practices internationally, in achieving a state off certainty and confidence for the investor. EIV emerges as an innovative model and solution to attract domestic and foreign capital. It aims to do this through connected services within a strong accountable public and private governance framework, in unlocking development and delivery barriers collectively. In addition, transparent project tools aim to test project viability through agreed and transparent viability criteria – which will in turn help prioritize key projects.

1.   Finance minister Smt Nirmala Sitharaman releases report of the task force on National Infrastructure Pipeline, Press Information Bureau, Government of India, December 2019
2.   Ease of Doing Business rankings, The World Bank, accessed March 2020
3.   PM's address on 'Ease of doing business', Press Information Bureau, Government of India, November 2018

The Economic Investment Vehicle: an integrated proposition to delivery in smart cities
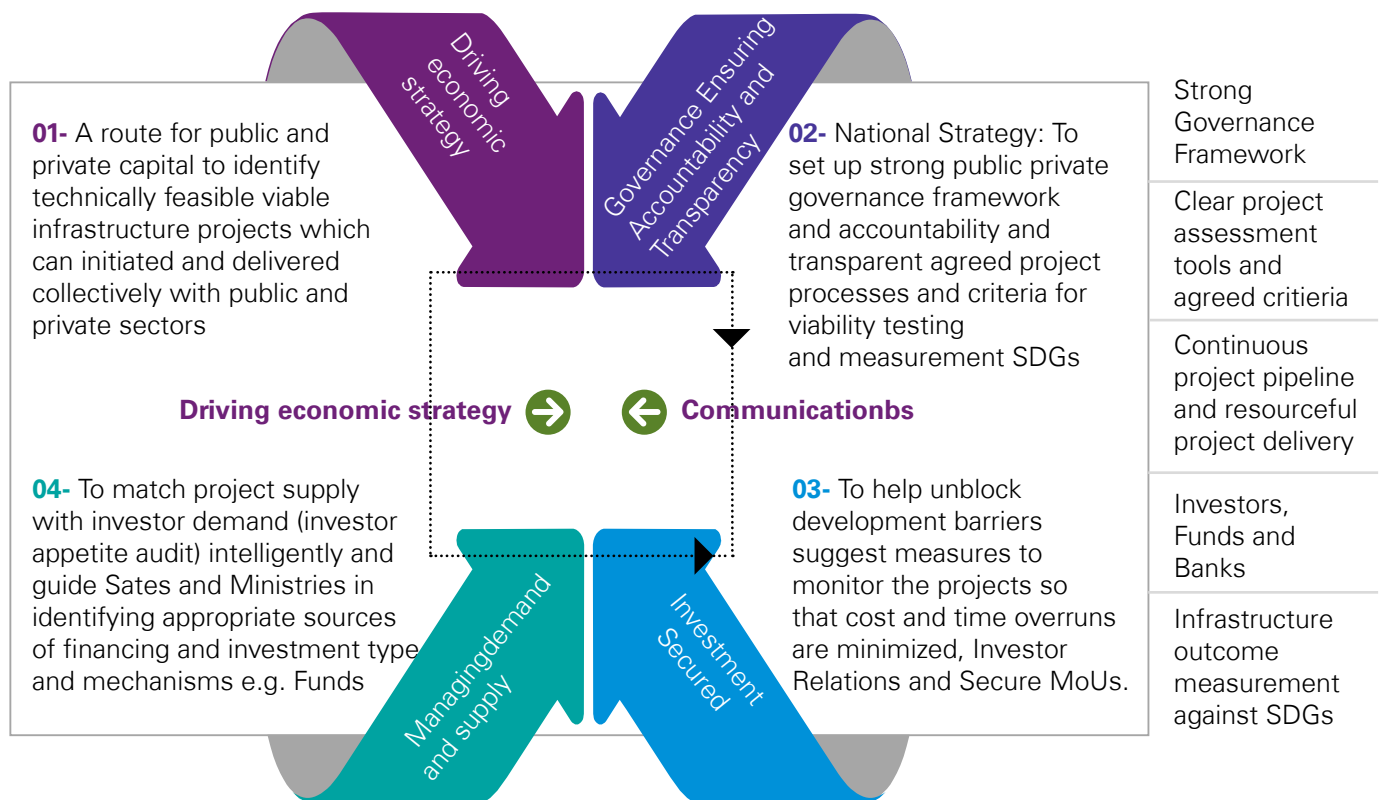
In order to unlock India's growth potential, a comprehensive and transparent strategy is required to attract investors and foster a business-friendly environment. Real partnerships and collaboration between the government and private businesses can pave the way for development.

An integrated approach through EIV aims to attract more investments, intelligently matching project supply with investor demand and appetite, and thereby creating jobs, exports and value. The EIV enables a framework of certainty and confidence for investment, with a focus on not just outputs but on measuring the impact of outcomes through the SDGs.

As a Smart and efficient tool, EIV aims to make India a preferred destination for investment among emerging markets through innovation and expertise in attracting and supporting new investors through infrastructure transactions.

KPMG's Economic Investment Vehicle EIV = Transferring International Models to a Local Country/City Context

Driving economic strategy

Governance Ensuring Accountability and Transparency

01- A route for public and private capital to identify technically feasible viable infrastructure projects which can initiated and delivered collectively with public and private sectors

02- National Strategy: To set up strong public private governance framework and accountability and transparent agreed project processes and criteria for viability testing and measurement SDGs

Driving economic strategy → ← Communicationbs

04- To match project supply with investor demand (investor appetite audit) intelligently and guide Sates and Ministries in identifying appropriate sources of financing and investment type and mechanisms e.g. Funds

03- To help unblock development barriers suggest measures to monitor the projects so that cost and time overruns are minimized, Investor Relations and Secure MoUs.

Managingdemand and supply

Investment Secured

Strong Governance Framework

Clear project assessment tools and agreed critieria

Continuous project pipeline and resourceful project delivery

Investors, Funds and Banks

Infrastructure outcome measurement against SDGs

Enabling certainty and confidence

The EIV is an integrated framework of distinct KPMG services, to channel public and private capital into a viable project pipeline of opportunities. This model brings transparent project selection tools in determining viability and project prioritization, as well as a framework of accountable public and private governance in overcoming development obstacles. There are three clear parts to the model:

Ensuring accountability – Clear public-private governance and aligned shared economic narrative help to unblock development barriers collectively, reducing political bias through clear terms of reference, thereby ensuring leadership and a governance framework of certainty for developers and investors

Enabling effective project prioritization, viability and delivery – Transparent project tools and defined selection criteria allow a ranking of projects. The key is also the measuring of real outputs (roads, houses etc.) and outcomes measured against Sustainable Development Goals (SDGs).

Securing investor confidence – An intelligent Investor Audit determines investor demand for projects at differing development cycles and asset class. This enables tailored investment and intelligent matching between project supply and investor demand/appetite. This can be achieved through a collective data base identifying investor appetite as well as project and investor matching through MoUs, success fees and deals with investors. The model recognises that investors have varied demands, ranging from long or short-term returns to a focus on social, economic or environmental returns. This can help to foster blended public-private finance initiatives. KPMG aims to explore the possible initiation of an infrastructure investment fund which will help kick-start priority projects.

Building for the future – A connected Smart City Approach to the Connected Urban Challenges of Today

Inequality
The income and resource gap between the rich and the poor is expected to widen. If left unaddressed, such inequalities could destabilize the society and overturn urban development benefits

Environment
The expanding middle class and changing consumption patterns are causing loss of biodiversity, pollution and climate change

Waste management
Poor waste management affects health, economic growth and environmental sustainability

Sufficiency and sustainability of energy
Population growth is expected to raise energy demand by 50 per cent by 2030, constraining supply and sustainability of fuel resources

Access to water
With the current approach towards water resources, more than 5 billion people could suffer from water scarcity by 2050

Connectivity
Densely populated and unplanned urban areas could result in congestion and longer lead times – need for thriving Sustainable Secondary Cities

The quality of India's infrastructure and its urban environment is central to the nation's development, helping to create jobs, raise living standards, and achieve the SDGs set by the UN. Given the role that India's infrastructure and urban environment plays in economic growth and quality of life, the government has increasingly focussed on attracting overseas investment into infrastructure, thereby unlocking major regeneration projects across the country. The government aims to equip the county with world-class infrastructure, enabling India to remain globally competitive.

There is a need for a project pipeline within existing Urban and Rural Centres and new Smart Cities that is both deliverable and investor friendly, within an enabling transparent governance framework. A connected plan needs to include strong new polices and targeted action to unlock and stimulate private sector investment. It would also enable public-private capital to deliver and materialize the infrastructure and investment goals as well ensure impactful and sustainable projects through key impact measurements of the projects in terms of jobs or resilience. In order to overcome the challenge of raising funds, more needs to be done in creating processes to achieve transparency in project selection and prioritisation, alongside a framework of accountable public-private governance. Project tools and clear terms of reference enable certainty and confidence of the developer and the investor. India's growth hinges on enabling capital and in delivering the resulting economic, social and environmental development.

Delivering Smart Cities of tomorrow – the scale of the global challenge and the need for a connected approach within India

The challenge, therefore, lies in adopting the right accountable governance processes and in identifying the right policy levers that foster innovation, and that also help unlock capital and catalyse collaboration alongside a strong and viable project portfolio. Smart Cities offer a unique opportunity to help navigate investment through an enabling structure, a central unit dedicated to both relationship management and unblocking any development obstacles.

The World's population is expected to grow to almost 10 billion by 2050, from the current eight billion[4]. Of which, close to 70 percent are expected to live in urban areas[5]. Cities are recognised as centres of economic growth and Smart Cities offer a unique and connected approach in accommodating this urban challenge, in the form on new "economic centres" of inclusive and connected growth through Smart Investment.

Limited public funds cannot alone meet the challenge and investor confidence in projects is key to securing private capital of USD 1.5 trillion by 2025.

To be a truly sustainable economy, India must adapt to the fourth industrial revolution including embracing the Smart Cities concept to deliver better public services. This also includes developing new forms of public-private collaboration. Such joint investment opportunities through new innovative approaches and Smart Investment, such as the Economic Investment Vehicle, would help deliver much needed and impactful infrastructure within an enabling ecosystem across Smart Cities in India.

Adopting the EIV to India – the urban infrastructure finance intermediary

Since the mid 1990's, some of the more progressive and urbanized States such as Andhra Pradesh/ Telangana/ Karnataka Urban have been developing State Urban Infrastructure Finance Intermediaries like Infrastructure Finance Development Corporations. Although primarily created to be an intermediary – often leveraging funds from externally aided projects, most of these entities have extremely limited lending or financial operations – and are engaged with mainly project development and/or administration of centrally sponsored and State plan schemes. In certain cases, these have been supported by multilateral and bilateral assistance in the form of sovereign debt – creating a lower cost of borrowing for municipalities that may borrow from such intermediaries. However, the lack of capacity at the municipal level to expedite projects appropriately as well as a lack of reforms that would service such debt ultimately dilutes the purpose of such debt. Also – almost none of these facilities have products that can be used by the private sector, thereby making PPPs inherently more expensive.

In India, the State Urban Infrastructure Finance Intermediary has been a constant fixture in several States, but its role has evolved over a period of time. The earliest of these were largely set up as a 'channel' to route funds obtained from Centrally sponsored and State plan schemes to municipal bodies, essentially working as an extended arm of the concerned Department of Urban Development, Housing or Municipal Affairs – but offering pass-through grants. Gradually, these moved to supplement the capacities of municipal bodies which could not conceptualize or develop projects on their own to take up such roles. Subsequently, they started offering finances sourced from Banks and other sources – notably international aid or banking institutions which have sovereign arrangements with the Government of India.

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4.   World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100, United Nations, 21 June 2017
5.   68 per cent of the world population projected to live in urban areas by 2050, says UN, United Nations, 16 May 2018

Looking back, these services offered by the different State Urban Infrastructure Finance Intermediaries can be graded into several stages of maturity:

Stage	Characteristics	Examples
Nascent/ emergent	• Do not have commercial lending operations, largely exist as a "shell" company of sorts; • May be co-opted by the State to offer grants received under Centrally sponsored schemes or State plan schemes as a 'pass through' system • May also be appointed as executing and/or implementing agency in case of projects funded by multilateral or bilateral lenders (varies from case to case depending on organizational maturity and State) • May engage in project development activities • Extremely lean staffing has limited freedom to choose staffing; most staff contractual except a managing director who is on deputation	BUIDCo (Bihar) JUIDCo (Jharkhand) MUINFRA (Maharashtra)
Emerging (type 1)	• Usually created as a Trust and not a company; managing trusteeship is with a State Government official and not a Trusteeship Company; Trust members are ex-officio members of the Government • Has limited lending operations – usually in a 'cooperative lending model' – where municipal bodies may contribute 'X' amount of monies per year and gain the ability to borrow 5'X'; rates of lending slightly lower than Banks and FI's, in some cases, a multilateral or bilateral donor may create the initial seed corpus • Is usually not entrusted with implementation of Centrally sponsored schemes or State plan schemes • Usually does not access capital markets, so shares or units are not traded (does not require SEBI approvals) • May or may not have a Fund manager; does not invest into other Funds, lends only to municipal bodies or other local authorities associated with urban development.	WBMDFT (West Bengal) OUIF (Odisha)
	• Variant: National Capital Region Planning Board, set up under an Act of Parliament, acting only within districts of Haryana, Rajasthan, Uttar Pradesh and NCT Delhi notified • Funds only select projects; preferably ones that run between States in the NCR • Has debt product only as of now, project development facility has now ceased operations • Has its own SPV for transport – NCR Transport Corporation	NCRPB (Government of India/ NCR) Haryana Urban Infrastructure Development Board
Emerging (type 2)	• Set up as a Company; either wholly by Government, or in joint venture with an NBFC • Carries out all functions of 'nascent/ emergent' state of maturity as above plus lending operations. • Has access to commercial banks for lines of credit; but has extremely limited product lines of debt. • May also be responsible for disbursements certain State plan schemes for meeting operating costs of infrastructure through grants • May have the ability to access capital markets but does not do so. • Is not registered as a 'loan company' under RBI Act, 1939, since borrowers are only public entities of a certain kind (e.g. municipal bodies)	TUFIDCO (Tamil Nadu) APUIFDC (Andhra Pradesh)TUIFDC (Telangana)KUIDFC (Karnataka) MPUDC (Madhya Pradesh) PMIDC (Punjab)

Stage	Characteristics	Examples
Developed	• Has characteristics of both sub-types of 'Emerging' • Is usually a combination of a Trust (set up under a managing Trusteeship Company) and a Fund Manager (a Financial Services Company) • Fund may be co-invested into by Institutional investors (needs SEBI approval); and Fund Manager may have shareholding from private Banks, SCBs and NBFCs • Usually is a trusted and de-facto channel for executing and/or implementing agency in case of projects funded by World Bank, Asian Development Bank, other multilateral or bilateral lenders; • Usually not be entrusted with offering grants received under Centrally sponsored schemes or State plan schemes as a 'pass through' • May offer a wider portfolio of financial products (guarantees, refinancing, debt consolidation, mezzanine etc.) • Has lending operations from 'funds' created from combination of borrowings from multilateral/ bilateral lenders, State Plan schemes and commercial banks, offering a 'blended' rate of interest – which may be differentiated based on purpose of borrowing • Is highly interested or accords great influence to reforms in terms of ensuring debt serviceability (prefers that the municipal body have its own debt servicing reserve as opposed to 'interception') • Accords high importance to project structuring • May also be in a position to lend to private parties in case of PPPs (needs registration from RBI as a loan Company)	TNUIFSL (Tamil Nadu) – not fully, it does not offer a lot of the products and/or services, but can do so if required.

The EIV unit could be fitted into the 'developed' category.

Agreed project prioritization

EIV is an innovative economic delivery and investment vehicle. It acts as a holistic one stop shop which covers end to end connected KPMG development services through project tools and an effective accountable governance framework.

We will support you in setting up of an EIV through a number of key connected work streams.

Workstreams:	KPMG Services:	Outputs:
Driving Economic Strategy	• Development of a clear strategy shared narrative • Ensuring Diversity of Partners and Expertise across the public and private sectors • Ensuring the Alignment of local, regional, national international policies and priorities enabling the joint commissioning of services across an authority • Aligning national and local policy priorities and funding availability	• Clear vision & strategy document that is aligned to local, regional & national policy • Identification of key internal & external stakeholders and stakeholder management plan
Governance Ensuring Accountability and Transparency	• Develop Public Private Project Governance Board • Define Terms of Reference (TOR(and Accountability - Clear divide between Board and Executive –Board gives advice and Executive deals with delivery • Ensure and "Honest broker" role • Develop Reporting Structures and Monitoring	• Set up Governance Board • Develop governance documentation (TORs, MOUs, progress reporting & KPIs)
Delivering Operational Process – Managing demand & supply	• Develop Project tools to assess project viability • Undertake clear Due Diligence on projects and data • Technical and specialist support teams – major projects • Project Sourcing • Agree Project Prioritisation and Ranking • Agreed Project Pipeline and Pitch Book Offer	• Project tools e.g. Project Initiation document, evaluation criteria etc. • Documented findings from Due diligence & project prioritisation pipeline

We will support you in setting up the EIV through the delivery of a number of key work streams. The services and outputs for each of these work streams are set out below:

Workstreams:	KPMG Services:	Outputs:
Investment Secured	• Identify and target key investors • Undertake Investor Audit – Determine investor appetite (questionnaire) • Match Project supply and demand • Commercial and financial transactions – deal making • Develop thinking around a new Regeneration Fund offering with partners	• Long list of investors & documented priorities • Identification of shortlist for investors • Transaction services support
Meeting KPIs KPMG True Values offering	• Measuring economic and social outcomes • Measuring against Government policies and targets – Appraisals • Meeting SDGs • Specialists - Economists	• Identification of KPI & development of KPI dashboard • Impact modelling
Communications	• Develop a Communication Strategy • Digital website • News letters • Pitch book • Key global infrastructure events and conferences – the sell MIPIM/Press	• Documented communication strategy • Ongoing management of investor relations

Help you achieve the following –:

Develop a Strong Governance Framework – transparent and Accountable
- This will Secure collective agreement of diverse partners, leaders/members in terms of resource allocation and project priority ranking
- Help unlock any political or policy barriers to project delivery (less arguments from a variety of diverse members for pet projects)
- Help target resources and funding into key projects
- Provides a clear divide in terms of roles and responsibilities between members (giving direction) and executives (technical expertise) in scoring projects – protects CEO and officers (from mayors, leaders etc. and managing expectations)

- Provide end to end specialist skills (which are increasingly missing in Councils) and clear processes across KPMG when and if needed different costs – from set up, to management and project assessment to investment secured

Clear Project Assessment Tools and a ranked continuous Project Pipeline
- A Project Initiation Document will allow a transparent technical project assessment tool in terms of determining viability and deliverability – rigorous technical agreed criteria
- Will demonstrate clearly how a project goes from a C to an A
- Will enable a maximising of resources to a project if it's a project A or where any additional grants or funding difficult sites may need funding
- A viable project pipeline, ranked and prioritised (with member and officer approval) to meet varying investor appetite and demand (de risking governance and project delivery issues) – a solid pitch book of opportunities

An Investor and Funding Audit – Understand better the needs of investors and funding availability
- ensure an intelligent match between project supply and investor demand – Investment secured
- Negotiate further match funding from Government and or other bodies –alignment of funds to projects that need a quick start (Housing Infrastructure Fund for difficult sites in priority areas)
- Could demonstrate possible JV between local developers and supply chain with an investor

- Measurement of outcomes from projects – economic, social and environmental values – measure growth and see outcomes – political win at a local and national level and with local communities – delivering on election promises and Government expectations – Delivering True Values Assessment in the Delivering of Outcomes and the Sustainable Development Goals

Nahid Majid
OBE Director, Director – Global Cities,
KPMG International

4 Affordable housing and land monetization in smart cities

Background

Over the past few decades, India has witnessed increasing urbanization and inward migration to cities, which has resulted in a significant change in the demographic profile of its urban centers. Consequently, housing demand has been concentrated in the mid and affordable segment.

However, there have been limited affordable housing focused developments owing to unavailability of low-cost land, increasing construction costs and low margins. Thus, a considerable demand-supply mismatch has resulted in India's cities. In 2012, it was estimated that about 18.78 million housing units were short/ missing in urban areas in India, and that about 95 per cent of these belonged to low income categories – commonly referred to as the economically weaker section and low-income groups[1] .

The advent of the PMAY or Pradhan Mantri Awas Yojna – after a long line of programmes developed to facilitate the provision of housing to the poor – attempted to create a new definition for 'affordable housing'. At that time, the Reserve Bank of India had a different definition as compared to what was used in Government schemes, notably any finished housing product (i.e. fit for moving in) that was priced at less than INR 50 lakh. Finally, in the Finance Act of 2017, affordable housing was added as a priority lending sector in the harmonized master list of infrastructure with a carpet area of 60 square meters and not exceeding a consideration of Indian Rupees Six lakh sans stamp duty and other statutory levies – a definition propounded from the scheme guidelines. The Reserve Bank of India has since updated its definition based on the definition as notified in the harmonized master list of infrastructure. In the Finance Act of 2019, affordable housing was redefined as a house or a flat with carpet area up to 90 sq. m. in non-metropolitan cities and towns, and 60 sq. m. in metropolitan cities and having value up to INR 45 lakh, for both cases. However, "affordability" is a very generic concept and could have varied interpretations – usually based on differences in income levels. Affordable and low-cost housing are often interchangeably used but are quite different from each other. They both differ in terms of the type of income class it caters to and the available supporting infrastructure.

Considering the housing shortage for Economically Weaker Section (EWS) / Low Income Group (LIG) segment in urban areas, the Indian Government launched the Pradhan Mantri Awas Yojna (PMAY)-U (Urban) in June 2015.

> "It is hard to argue that housing is not a fundamental human need. Decent, affordable housing should be a basic right for everybody in this country. The reason is simple: without stable shelter, everything else falls apart
>
> **Matthew Desmond**

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1. Report of the working group for estimating India's urban housing shortage, 2012, Ministry of Housing & Urban Poverty Alleviation

National level House Completions PMAY -U (Y-o-Y Physical Progress)
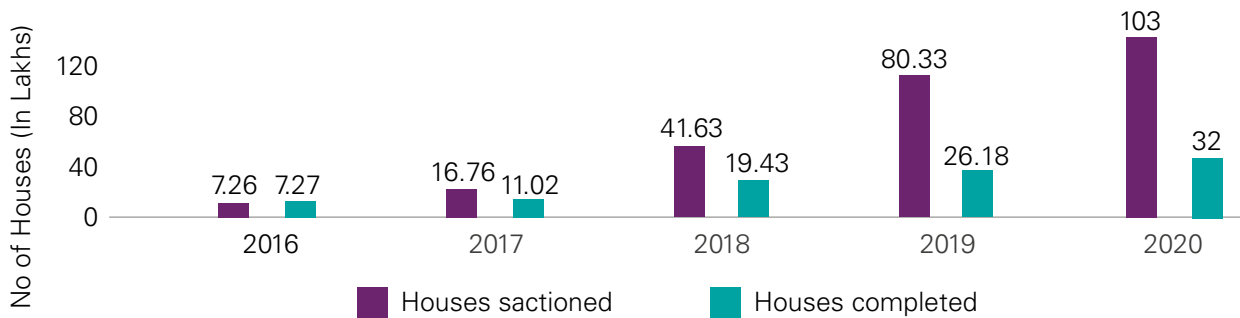
Source: Pradhan Mantri Awas Yojana website, https://pmay-urban.gov.in, accessed on March 2021

As on 28 February 2021, Gujarat, Madya Pradesh, Maharashtra, Uttar Pradesh and Tamil Nadu were the top five states with an aggregate ~24.43 lakh[2] houses completed under PMAY-U.

Convergence of Smart Cities and Affordable Housing

As indicated elsewhere in this publication, the Smart Cities Mission is, unlike other schemes that target the creation of specific assets, a 'compound' scheme that does not focus on the creation of any one specific kind of asset – but on a wide range of projects that 'add to' the normative assets to make them particularly usable for the people and more importantly improve the quality of life and living conditions for all residents. As shelter is a basic necessity for sustenance, Smart Cities Mission guidelines included this basic requirement as part of being able to be called 'smart'. In every one of the 100 cities eventually selected, the Pradhan Mantri Awas Yojna (Housing for All – Urban) scheme was already active, even before the city was selected to receive funding under the Mission. The objective was therefore – to leverage the scheme to an extent where the shortage of housing stock could be addressed in a sustainable manner, that essentially improved access to housing. Projects already sanctioned under the PMAY scheme, wherever spatially convergent with the projects under Smart Cities Mission – were termed as being of 'convergence' category. However, as evidence would indicate, the structure of the Smart Cities scheme was such that such projects could not be taken up by default – since the bulk of the funds were meant to be invested into a limited area of the city – identified as 'area based development' (ABD), and Mission funds applied outside the area could only be for non-brick and mortar projects – such as city wide IT enabled systems. Projects under PMAY or any State sponsored schemes for provision of affordable housing have continued nevertheless within the city – albeit not being part of the 'Smart City' envelope.

In 2018, perusal of the database of projects registered under the Smart Cities Mission indicated that the housing sector is the third largest development category in the Smart City Mission with a budget of INR 16,381.2 Crore[3]. Approximately half of the projects were devoted to real estate development, with the other half being a mix of mid and lower income housing. However, over a period, it was found that while the projects were indeed there, they were being counted from areas outside the ABD, which was not supposed to be considered as part of the Smart Cities deployment.

The implementation of Smart Cities Mission also coincides with another major step in real estate regulation – that of the implementation of the Real Estate (Regulation & Development) Act, 2016 – which came into effect in full force from 1 May 2017. Originally enacted to protect the interest of homebuyers from malpractices frequently carried out by promoters – the law also equates any local body, authority or housing board which develops housing products for the intent of sale or leasing ("transfer of property") would also count as a "promoter" under section 2 (zza) of the Act. This step would affect two of the four lines of funding assistance under PMAY – that involved construction of housing products. A separate line, that offered subsidies on interest rates was also affected to the extent that the product(s) on which interest rates were to be applied in the case of a housing loan for the same – would have to be approved by the Real Estate Regulatory Authority of the State. The one line that remained unaffected – and still accounts for almost 80 per cent of the housing stock produced under PMAY falls under the beneficiary led construction programme – which offers capital subsidy to the beneficiary for construction or improvement of her/ their[4] house on land already owned or legitimately occupied by them.

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2. Pradhan Mantri Awas Yojana website, https://pmay-urban.gov.in/, accessed on 12 March 2021
3. Center for Policy Research Smart cities data base, 2018

4. As per the scheme guidelines, women or a husband-wife couple beneficiaries were accorded priority in terms of the funds.

Influencing the affordable housing market

Even as the PMAY was aiming to facilitate creation of affordable housing for the poor, the question as regards what was happening with respect to making housing affordable for the poor still remained. To this extent – the interest rate subsidy scheme was meant to play an important part – improving accessibility to housing through a long tenure loan at a discounted rate – effectively implying a lower EMI for beneficiaries. The question was – whether private sector parties were actually producing housing stock within the said segment or not; and more importantly – whether banks were interested to cater to this segment of consumers.

Many low-income households suffer from 'informality of income', which makes it difficult to secure adequate evidence to make them credit worthy. In fact, even in the case of the beneficiary led construction programme – it was found in many cases of beneficiaries that availing of interest rate subsidy would be easier on cash flows of a low income household – yet municipal bodies chose to offer the direct subsidy instead – which not only implies a greater cash outflow for a low income household at the time of creation of the asset, but also results in a smaller house (many States imposed a limit of 25 to 30 square meters, in comparison, the interest rate subsidy could be supported up to 60 square meters). However, the lack of formal or structured income caused such households to be deemed less credit worthy and had to fall back to direct subsidy. As on date, a large number of such houses stay incomplete across many States on account of inability of the household to meet the balance costs for construction of the house.

However, the mismatch of an appropriate form of subsidy is not the only issue that plagues affordable housing. Several other issues also emanate from the current structure and form of delivery. Some of these are notably:

Limited support to private sector: Several States in India formulated their own affordable housing policies during 2014-15, and some before that – as part of the reform regime proposed under PMAY. In many cases, private developers were mandated to create mixed-group housing, where a certain percentage of housing stock would be left for low income segments. For each of these housing units, PMAY was meant to contribute an amount of INR 1,50,000. However, as things stood, till date –private sector developers have received little to no support under PMAY for lands owned by them – except for being linked to the interest rate subsidy

scheme. In cases where the developer co-develops housing stock for low income segments, State policies usually mandate that these housing units be transferred 'free of cost' to a designated agency – usually the State Housing Board for onward allotment to low income households.

This was based on the assumption that the pricing of the higher income group housing could cover for the cost of the low-income houses as well in their entirety – a concept arising from the Slum Rehabilitation Scheme in Mumbai, where it is possible to provide free houses to the poor since the land values are too high. Unfortunately, with the slump in real estate sector – many of the housing products created for higher income groups also remained unsold – prompting many developers to seek exemption from construction of low income housing through payment of 'shelter fee'. This amount, collected by the State would be used to develop housing for low income segments at alternate sites, except that at the time – there were no viable alternative sites within the city – and housing products that were on offer – usually at far flung locations from the beneficiaries' place of work - were simply not acceptable to the households. Some States such as Rajasthan, vide their Affordable Housing Policy from 2009 – attempted to 'buy back' the constructed houses from the developer at a pre-determined rate, passing only that cost to the beneficiary. This was successful for a while, but eventually abandoned.

Lack of proper structured financing options for low income segments: The mortgage to GDP ratio in India is one of the lowest in the world – close to about 1 per cent. By some estimates, about 70 per cent of retail asset lending by commercial banks and housing finance institutions lie with Mid Income Group (MIG) and High-Income Group (HIG) segments. Micro-finance institutions, which have traditionally helped many low-income households meet day-to-day expenses through extension of short-term credit – usually do so at considerably inflated rates on account of an upstream high cost of funds. Interestingly, group credits – drawn in this manner through thrift and credit 'societies' have a reasonably high rate of recovery, compared to formal banks in terms of retail assets. The interest rate subsidy scheme under PMAY was never adapted to fit group credit models through intermediaries. This could have been done through coordination between community-based organizations, State Level Banking Committees (SLBC) and a provider of housing products – such as a housing board, trained to work on alternative models.

Cost effective materials and construction technology: In the 1980's and 1990's – the building center movement caught considerable traction in India, opening the possibility of usage of a plethora of new construction technologies and materials for mass housing. However, many of these, despite their promotion – were never mainstreamed into construction practices. As a result of this, the popular perception that prevailed over the next couple of decades was that low-cost material was synonymous with poor quality construction, seen as an aberration and generally rejected – even by low income households. With beneficiary led construction being the single largest mode of delivery of houses under PMAY, this was a fair opportunity to try/adopt many of these models in bulk – often at discounted rates from mainstream construction. However, many States refused to engage with service providers stating that this would be anti-ethical to the spirit of the construction being 'beneficiary-led'. Only in a few States such as Andhra Pradesh were technologies such as GFRG (Glass Fibre Reinforced Gypsum) used as standard issue materials – often through housing units constructed by entities such as the Andhra Pradesh State Housing Corporation – an entity whose counterpart does not exist in most other States.

Whither cooperatives? The cooperative movement in India has seen considerable success in matters of dairy, agro-produce and in certain cases, affordable mass housing as well. However, none of the last few Government programmes have utilized, or even promoted - cooperative models for creation and maintenance of housing – save one project in Solapur, Maharashtra – which pertained to a mass housing project for a federation of Beedi factory worker associations. Structurally, cooperative housing systems are not very different from housing association models in United Kingdom, which is well known to work as a source of affordable housing production and availability in the country. However, the matter of cooperative societies is State subject and is often seen as a potential source of mismanagement of funds. As of now, there is no restriction for States to revamp cooperative laws to make them more conducive to affordable, community-based housing systems – as well as use them as intermediaries. In fact, the National Cooperative Housing Federation has a mandate to extend line of credit to cooperatives for construction as well as on-lending to its members.

Case study: learnings from Rajasthan's affordable housing policies

In the early years of PMAY-U, nearly every State in India During the late 2008's – at the peak of the JNNURM scheme, most States were faced with the prospect of 'shaping' their housing markets to improve accessibility for low income groups in the normal course of business as opposed to being dependent on a Centrally sponsored scheme. Already, the National Housing & Habitat Policies of 1994, 1998 and the National Urban Housing & Habitat Policy of 2007 had stipulated that (i) the role of the Government would be to facilitate provision of housing for low income segments as opposed to actually developing them, and (ii) that the private sector would have to be partnered with in order to meet the housing shortfall.

As it was within the State of Rajasthan, the number of housing units produced by private developers was significantly more than what was being produced by public authorities like Development Authorities, Housing Board, Urban Improvement Trusts, Industrial Development and Investment Corporations and so on. Furthermore, these entities were governed by regulations that were often not flexible to the varying needs of low-income segments or the ability to engage with the private sector in a more flexible or adaptive manner. It was keeping in view that the Government of Rajasthan came up with an innovative affordable housing policy in 2009, which has since been updated twice in 2015 and 2017 respectively. The 2009 policy is often regarded as one of the earliest 'policy' level efforts in India that focuses on the transactional arrangements between the public & private sector to provide for housing – notably the ability of the Government to engage directly with developers & promoters who already had land with them. Further, noting the shortcomings of traditional Government bodies, the Government of Rajasthan constituted a new entity out of the Rajasthan Housing Board, namely the Rajasthan Awas Vikas Infrastructure Limited, designed to address the issue of low income segments in line with the policies and using non-conventional means of engagement.

In 2015, after the launch of the Pradhan Mantri Awas Yojna (Housing for All – Urban) scheme States were expected to follow the definitions and standards associated with Economically Weaker Sections (EWS) and Low Income Groups (LIG) as stipulated under the scheme, they also had the option of developing their own thresholds on the income aspects based on ground conditions within their jurisdictions. Government of Rajasthan, which had in 2009 adopted the standards set forth by the Deepak Parekh led Committee (2008), now adopted a slightly more liberal standard, attempting to find a balance between the stipulations of the older policy of 2009 as well as the standards supported under the Integrated Housing & Slum Development Programme, a Centrally sponsored scheme that had attempted to achieve the same results until 2014 in smaller towns and which was still continuing. Although these space standards were lower than the Nationally prescribed parameters, they were still compliant with IS:8888, part 1 (1993) – the BIS code for housing for low income segments.

The most striking feature of the policy was its ability to mainstream low income group housing into all forms of formal development, notably the following models:

Model 1A
Reservation of Housing for low income groups within Residential Schemes of municipal bodies/ urban improvement trusts/ Development Authorities/ housing board and private developers.

Model 1B
Provision/ reservation of housing within industrial schemes of Rajasthan Investment and Industrial Development Corporation and private developers

Model 2
Development of affordable houses by Private Developer on Private Land in Partnership (at least 50 per cent of the land area)

Model 3A
Development of flats for EWS and/or LIG segments by private developer on whole of private land (flatted development, above G+3 format, 100 per cent housing stock

Model 3B
Development of flats for EWS and/or LIG segments by private developer on whole of private land (flatted development, above G+3 format, 100 per cent housing stock)

Model 4
Development of flatted units by private developer on Government land or land held by local authority, with 75 per cent housing stock for EWS/LIG and 25 per cent for sale in open markets

An older model from the 2009 policy, that incentivized redevelopment of slum pockets to accommodate dwellers into newer tenements on the same site and usage of the balance area for commercial capitalization (i.e. land as a resource) was discontinued in 2015 as it was also included as part of the PMAY-U. Also, an older segment of MIG-A, which had been part of the 2009 policy was discontinued. As per the new policy, particulars of the tenements were as follows:

Particular	EWS segment	LIG segment
Super-built-up area (note that PMAY-U specifies carpet area)	(30 to 32.5 sq. meters) 2 habitable rooms, 1 kitchenette, 1 water closet, 1 bath and a wash basin space along with a balcony of 4' x 3' (or courtyard)	(46 to 51 sq. meters) 3 habitable rooms, 1 kitchenette, 1 water closet, 1 bath and a wash basin space along with a balcony of 4' x 3' (or courtyard)
Effective price	For flatted development: INR 1,200/- per sq. foot (effective INR 3.90 to 4.20 lakh) For plotted development: 25 per cent of reserve price of developed land (varies from place to place) Stamp duty of INR 50/- per transaction (plot/ flat)	For flatted development: INR 1,200/- per sq. foot (effective INR 6.00 to 6.60 lakh) For plotted development: 60 per cent of reserve price of developed land (varies from place to place) Stamp duty of INR 100/- per transaction (plot/ flat)

Other enabling features

Further, to discourage speculative capture of these stocks by purchasers from other, higher income categories, a slew of other regulations were introduced as part of the conditions of allotment:

- Approvals to the projects were provided within 60 days.
- Allotted units were expected to be occupied within one year of allotment, along with a lock-in period of 10 years from the date of allotment for any form of sale or transfer.

The policy has led to creation of over 120,000 new housing units and affordable plots all over the State. The Rajasthan Policy has succeeded in becoming one of the most comprehensive packages of incentives while dealing with a complex amalgam of factors addressed at all levels of implementation in a synchronized manner.

Dedicated Reserve/ Corpus Fund

A common concern noted during the implementation of the policy was the fact that several developers appeared to be facing the shortage of working capital credit for construction of EWS and LIG housing stocks, and construction linked payments (CLP) from allottees were not being passed frequently enough to the developer, resulting in slowdown or stoppages in work. To alleviate this problem, a corpus of Rs 100 crore was created within RAVIL for advancing funds to the developer on the executed work without delays. This corpus essentially serves as a feeder to project specific escrow accounts. After the enforcement of Real Estate (Regulation & Development) Act, 2016, this serves to meet the project corpus, which must be maintained in an escrow account that maintains at least 70 per cent of receivables under the project till the time it is not treated as complete.

Improving ease of access to finances

Traditionally, banks and housing finance institutions have typically been averse to lending to EWS & LIG segments on account of high risks of default. To overcome this impediment, a tripartite arrangement also exists between the banks & housing finance institutions with the beneficiary and the public authority or body (RAVIL) that in case of default, the public body will arrange for the attachment and disposal of the asset to repay the dues of the bank or financial institution. This process partially insulates banks and financial institutions from high administration costs and liabilities in case of default. In some schemes, in order to make the portfolio more attractive to the Bank, financing arrangements are pre-emptively entered into on a near-exclusive basis. Under this, RAVIL typically enters into an arrangement with one to two banks to provide the most attractive terms of interest and loans for all EWS and LIG category houses, ensuring that most of the allottees necessarily go to these banks, increasing the portfolio size for the bank and reducing administration cost per retail asset. An interesting variation that has been done is that much of the KYC (Know Your Customer) regulations that ordinarily govern banks in terms of financing retail assets have been addressed at the level of RAVIL itself, and as a result banks now seek only proof of identity and address from the allottee. NGOs have been highly instrumental in helping allottees in filling up requisite forms and facilitating KYC compliances with RAVIL as well as banks.

Possible Measures to Resolve Above Challenges

Government to provide additional Incentives on land cost under affordable housing segment to developers. Special focus on selection of land parcels for ABD ensuring financial viability of the affordable housing project.

In Proposals 'affordable housing' should be defined with clear income-based criteria to ensure that it is within the financial means of EWS/LIG. Focus on greenfield development for affordable housing projects as part of the ABD projects rather than redevelopment of existing developed areas.

Strengthen Micro Finance - Government needs to provide assistance to EWS / LIG to access housing microfinance and other financial tools. Micro finance companies also need assistance in terms of availing long-term affordable money.

Advanced construction technology can reduce the cost of construction and time taken to build the project. A great initiative by The Ministry of Urban Housing Affairs is the Global Housing Technology Challenge (GHTC) to identify global technologies for construction from across the world. The challenge encompasses construction of six Light House Projects (LHP) with six distinct technologies with ~1,000 houses each within a year across key cities such as Rajkot, Indore, Lucknow, Ranchi, Agartala & Chennai[4].

4. The Hindu article, PM unveils project for affordable housing, https://www.thehindu.com/news/national/pm-modi-lays-foundation-stone-of-six-light-house-projects-in-six-states/article33470436.ece, accessed on 14 March 2021.

Financing infrastructure through monetization of land

Context

Land holdings owned by government entities are one of the most significant tangible assets that have never been tapped to the fullest potential. Land Monetization is one of the viable options for government entities or 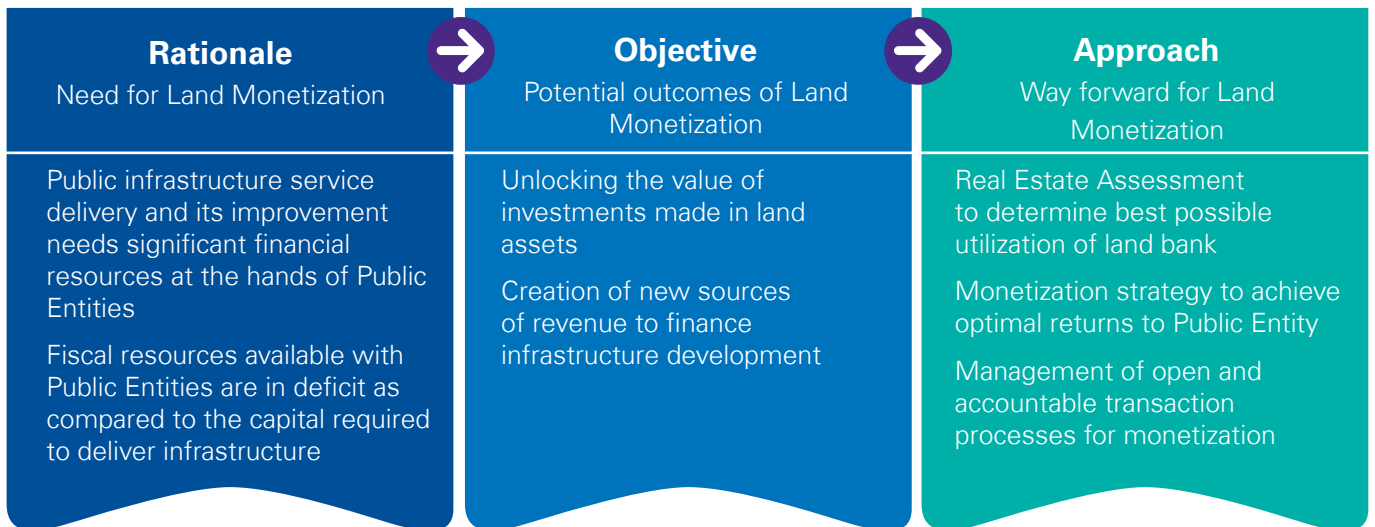Urban Local Bodies for financing the upgradation or development of public infrastructure by tapping the commercial potential of such land assets which are otherwise unutilized or under-utilized. Land Monetization provides an alternative option to the government entities or local bodies for generating funds required for infrastructure delivery without burdening the exchequer.infrastructure and cities in general, the economic and human potential of India would never be utilized.

> "
>
> We hope to achieve the (fiscal) consolidation by first, increasing the buoyancy of tax revenue through improved compliance, and secondly, by increased receipts from monetisation of assets, including Public ector Enterprises and land."
>
> **Nirmala Sitharaman,**
> Finance Minister, Government of India
> Budget speech on 2nd Feb 2021

Rationale →	Objective →	Approach
Need for Land Monetization	Potential outcomes of Land Monetization	Way forward for Land Monetization
Public infrastructure service delivery and its improvement needs significant financial resources at the hands of Public Entities	Unlocking the value of investments made in land assets	Real Estate Assessment to determine best possible utilization of land bank
Fiscal resources available with Public Entities are in deficit as compared to the capital required to deliver infrastructure	Creation of new sources of revenue to finance infrastructure development	Monetization strategy to achieve optimal returns to Public Entity
		Management of open and accountable transaction processes for monetization

Infrastructure developments possible through Land Monetization
Financing projects across broad spectrum of asset classes
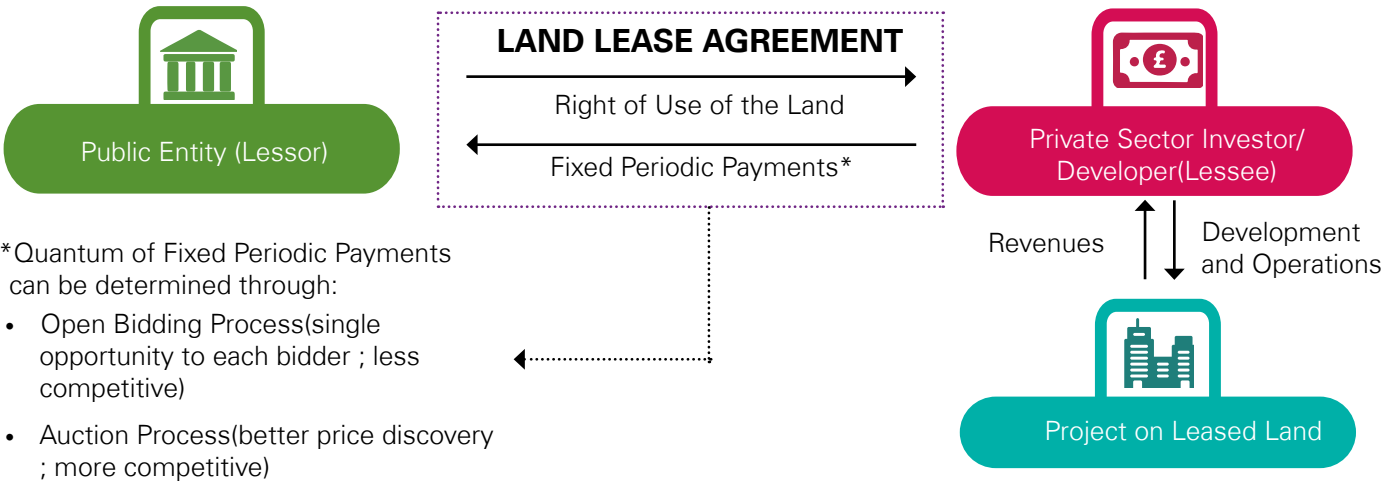
Residential Developments	Commercial / Mixed Use Developments	Tourism & Recreation Infrastructure	Urban Infrastructure	Industrial Infrastructure
• Integrated Townships • Affordable Housing • Industrial Housing • Govt./public Housing Complexes • Student Housing • Co-living Spaces • Senior Living, etc	• Business Districts • Co-working Spaces • Mall / Shopping Complexes • Retail / Wholesale Markets • Data Centres, etc	• Hospitality: Hotels, Resorts, Serviced Apartment, etc • MICE: Convention centers, exhibition centers, expo halls, etc • Theme Based Developments: Entertainment Districts, Amusement Parks, etc • Sports Infrastructure	• Multi-modal Transport Terminals, Bus Terminals, etc • Transit Oriented Developments along Metro Corridors / Highways • City Side Developments at Greenfield / Brownfield Airports • Way-side amenities • Parking Complexes	• Industrial Parks / Corridors / Nodes(multi-product or sector specific such as IT/ITeS, Agro, Auto, Pharma, Textile, etc.) • Industrial Townships • Logistic Parks • Warehousing & FTWZs

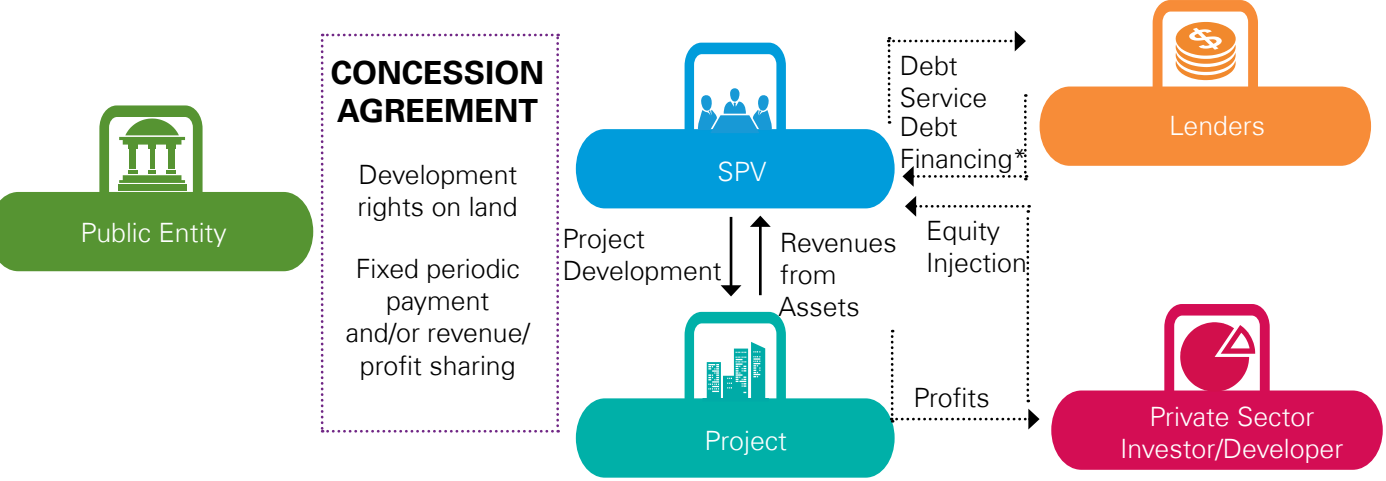## Options for monetization of land

Land Monetization process warrants leveraging various public-private partnerships (PPP) models as it combines the best of both entities—public interest of the public sector along with expertise of the private sector. Below potential structures can be looked at while undertaking land monetization processes using Public-Private Partnerships (PPP) models:

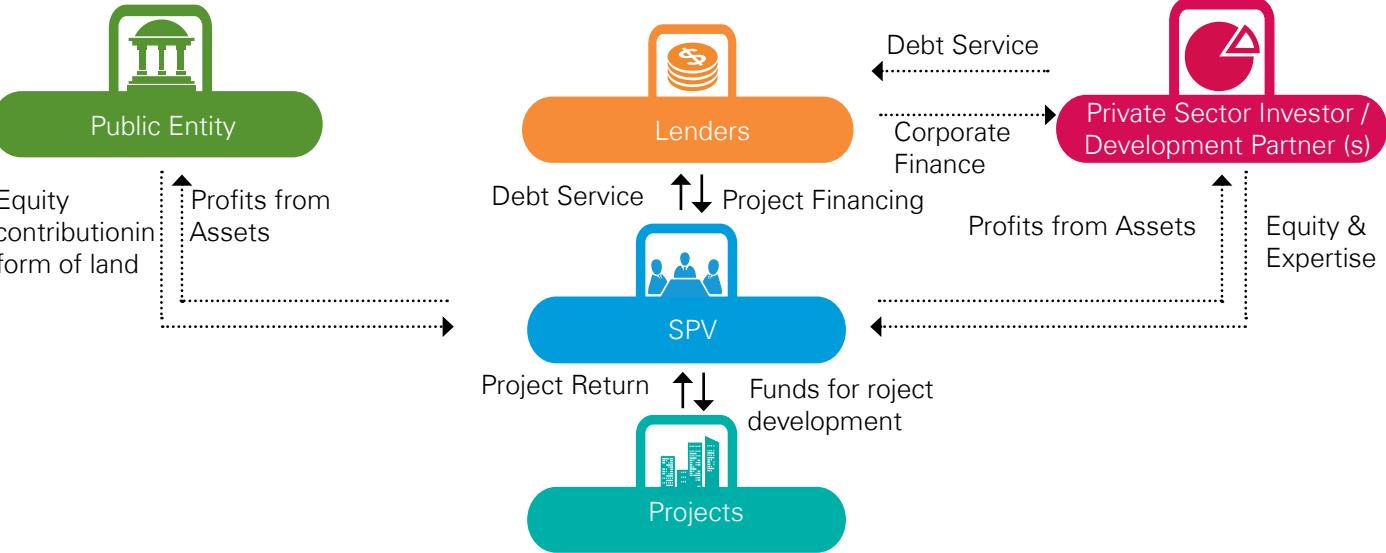| Contractual structure Options	01 - LAND LEASE	02 - CONCESSION	03 - JOINT VENTURE
Key Features	Fixed periodic payments over the lease term	Public Entity contributes land into the project and grant development rights in return to fixed payment and/or revenue/profit share	Public Entity contributes land as its equity into a SPV (created for project development) and receives earnings based on its shareholding in SPV
Payment Structure	100% borne by the Private Sector Investor / Developer	Fixed periodic payment and/or revenue/profit sharing over concession / contract term	Profit sharing by each partner based on its shareholding in SPV
Revenue Risk / Demand Risk	Can be used for commercial, tourism & recreation and social infrastructure developments	Mostly borne by Private Sector Investor / Developer(Public Entity has certain exposure to demand risk in case of revenue sharing arrangements)	Shared Risks between Public Entity & Private Sector Investor / Developer
Potential Application	Do not have commercial lending operations, largely exist as a "shell" company of sorts; May be co-opted by the State to offer grants received under Centrally eputation	Can be used for residential, commercial, hospitality, mixed use & urban infrastructure developments	Can be used for residential, commercial, mixed use & industrial infrastructure developments

01- LAND LEASE

Lease Agreements have a simple contractual structure where Public Entity enters a lease agreement in return for fixed periodic payments.

Public Entity (Lessor)

LAND LEASE AGREEMENT

Right of Use of the Land

Fixed Periodic Payments*

Private Sector Investor/ Developer(Lessee)

Revenues | Development and Operations

Project on Leased Land

*Quantum of Fixed Periodic Payments can be determined through:
- Open Bidding Process(single opportunity to each bidder ; less competitive)
- Auction Process(better price discovery ; more competitive)

01- CONCESSION

Concession Agreement gives Private Sector Investor/Developer a right to implement and operate (subject to certain terms) the envisaged project within Public Entity's jurisdiction

Public Entity

CONCESSION AGREEMENT

Development rights on land

Fixed periodic payment and/or revenue/ profit sharing

SPV

Project Development | Revenues from Assets

Project

Debt Service Debt Financing*

Lenders

Equity Injection

Profits

Private Sector Investor/Developer

* Project financing is raised at SPV level and is paid into the escrow account established for project development

03- JOINT VENTURE

Joint Venture agreements allow partners to agree on complete structuring and operating models upfront

Public Entity

Equity contributionin form of land | Profits from Assets

Lenders

Debt Service

Private Sector Investor / Development Partner (s)

Debt Service | Project Financing

Corporate Finance

Profits from Assets | Equity & Expertise

SPV

Project Return | Funds for roject development

Projects

Allocation of of Risks amongst 'Public Entity' and 'Private Sector Investor/Developer' under various Contractual Structures

Type of Risk	Land Lease Agreement		Concession Agreement		Joint Venture Agreement	
	Public Entity	Private Sector Investor / Developer	Public Entity	Private Sector Investor / Developer	Shared Risk	Shared Risk
Design & Construction Risk	No Risk	Risk	No Risk	Risk	Shared Risk	Shared Risk
Operating Risk	No Risk	Risk	No Risk	No Risk	Shared Risk	Shared Risk
Demand Risk	No Risk	Risk	Shared Risk	Shared Risk	Shared Risk	Shared Risk
Financing Risk	No Risk	Risk	No Risk	Risk	Shared Risk	Shared Risk
Regulatory Risk	Risk	No Risk	Risk	No Risk	Risk	No Risk
Remarks	Majority of risks are borne by the lessee (i.e. private sector investor/developer)		Majority of the risks are borne by the private sector investor/developer. (Public Entity may have certain exposure to demand risk in case of revenue sharing arrangements)		Profits and risks are shared proportionally among the JV partners	

Comparison of Contractual Structures from Public Entity's Perspective

Public Entity's Objectives	Land Lease Agreement	Concession Agreement	Joint Venture Agreement
Benefit from upside revenue potential		✓	✓
No/Limited exposure to demand risk	✓	✓	
Better potential for economic boost and land appreciation		✓	✓
No involvement in operations	✓	✓	
Ease of implementation	✓	✓	
Land ownership stays with Public Entity*	✓	✓	

* Under a Joint Venture agreement, the land ownership is to be transferred to the Project SPV

Comparison of Contractual Structures from Public Entity's Perspective

Contractual structure Options	01 - LAND LEASE	02 - CONCESSION	03 - JOINT VENTURE
Key Features	• Land ownership remains with Public Entity • Most risks (including demand risk) are allocated to Private Sector Investor / Developer. • No cash outlay from Public Entity • Hedged downside risk for fixed periodic payment • Stable long term cash generation • Simple bid structure • (highest lease payments)	• Public Entity may retain ownership rights on Land as well as assets created on it. • Majority of risks are transferred to Private Sector Investor / Developer • Demand risk is mostly allocated to the party better able to manage it • Private Sector Investor / Developer is responsible for Project financing • Potential revenue upsides for Public Entity from project's performance	• Enables Public Entity to harness the private sector's expertise and efficiencies in operations while sharing benefits • Public Entity is entitled for profit share in accordance with its shareholding percentage in SPV (Joint Venture Company) • Potential of achieving higher returns compared to other contractual models • Partnership allows to gather best resources of different parties

Key considerations and approach for land monetization process

A process-driven approach for monetizing the land assets could generate significant annuity revenues for the government. For any public sector entity, the first critical step in a Land Monetization process is creating an inventory of its land assets. After a thorough mapping of the land assets, the government organization can shortlist assets that are to be prioritized for monetization.

Approach for Land Monetization - Ensuring maximum value gain to Public Entities

Best Use Study & Project Conceptualization	TransactionStructuring	Managing Pre-transaction & Post-transaction Processes
Evaluation of options for unlocking maximum commercial potential	Identification of Optimal Monetization instrument	Competitive bidding process to identify most suitable investor
• Land Analysis: Assess the potential of land bank from local & regional perspective • Regulatory Assessment: Study govt policies & development control regulations to estimate the typology & quantum of potential development • Real Estate Market Study: Demand-supply analysis to determine highest & best possible use of land and to define contours for optimum utilization • Financial Feasibility Analysis: Analyze viability from investor's perspective and to assess the returns for government	• Scenario & Sensitivity Analysis: Form a 'guided value' that can be used as a benchmark / reserve price for the transaction • Evaluate various options of possible monetization instruments: Identify risks and possible mitigations measures / risk allocation mechanisms under each option • Identify most optimal transaction structure while creating a framework and finalizing bidding methodology	• Preparation of Bid Documents for selection of preferred investor • Pre-Bid Marketing & Information Dissemination to prospective investors • Evaluation of proposals submitted by prospective investors / bidders • Execution of Definitive Agreement between Public Entity & selected Private Sector Investor/Developer • Post-transaction monitoring and contract management

Key considerations for Land Monetization Process:

- Land monetization is a value capture exercise and it should be undertaken only if the viability and benefits are demonstrated through adequate due diligence.

- Approval processes like land-use change, environmental approvals, statutory approvals for relaxation in development controls, etc shall be appropriately aligned for optimum utilization of the land assets.

- Sufficient checks and balances should be incorporated in the Land Monetization exercise and all the stakeholders including the public should be sensitised.

> **"**
>
> Land Monetization is an exciting idea that offers an alternative to traditional financing mechanisms with tremendous potential to augment revenues for public sector entities and to supplement investments for speedier infrastructure development through private sector intervention.
>
> **Chintan Patel**
>
> Partner,
> Deal Advisory and Head - Building,
> Construction and Real Estate
> KPMG in India
>
> **"**

Nitika Krishan
Associate Director,
Government Advisory,
KPMG in India

5 Improving coverage and retaining sustainability in water and sanitation

Background

Most urban development schemes in recent years have been synonymous with improvement of water supply & sanitation – ranging from the earliest targeted programmes such as Accelerated Urban Water Supply and Sanitation Programme in the 1990's. The trend continues through later Centrally sponsored schemes such as JNNURM and AMRUT. However, what has remained by and large constant is the coverage of urban households in terms of water supply & wastewater - with most cities not reaching 100 per cent and being stagnant for the last several years. The last several schemes by the Government of India have ensured an increase in the number of hours of water supply, but the stagnancy in terms of connections continues, as does the matter of meeting operating costs. Now, the proposed Jal Jeevan Mission (already launched for rural areas) proposes to make up for the matter of coverage by ensuring piped water supply to every urban household – with an amount of INR 2,87,000 crore having been provisioned for the next five years as per the budget speech of 2021-22 by the Finance Minister.

The Swachh Bharat Mission was the first program to dedicatedly focus on the issue of urban sanitation in India, SBM-U has seen significant achievements and progress in the last six years. Urban areas in India become open defecation free (ODF)[1] and the percentage of solid waste processing, which stood at a mere 18% in 2014, has more than tripled and now stands at 68%. Now, the Government of India proposes to launch SBM-U 2. 0 as a continuation of SBM-U, that widens and deepens the learnings and efforts from the prior phase. the foundations having been already firmly established in the first phase of the Mission, this announcement is not only a reiteration of the Government's commitment to ensuring clean water, sanitation and clean environment to every citizen of India but also brings to the forefront the importance of safe and sustainable sanitation for universal health, well-being, overall economic prosperity and ease of living.

A total outlay of INR 1,41,678 crores has been announced for SBM-U 2.0 for the next 5 years. As mentioned in the Budget speech, the Government will focus on wastewater treatment and complete faecal sludge management in all cities with population of less than 1 lakh and bioremediation of all legacy dump sites through holistic solid waste management; as well as providing universal coverage of water supply, wastewater treatment, rejuvenation of water bodies and promote circular economy of water.

However, these aims are not without their share of challenges that need being overcome. Key amongst them are considerations of institutional arrangements, sustainability of sources and the economic and environmental sustainability of services provided. These issues have been discussed one by one as below:

> **Because no matter who we are or where we come from, we're all entitled to the basic human rights of clean air to breathe, clean water to drink, and healthy land to call home**
>
> **Martin Luther King III**

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1. Except for 12 Urban Local Bodies of West Bengal as per data from Ministry of Housing & Urban Affairs, Government of India where data has not been made available by the State

Our water footprint

Perusal of the water resource allocation in India reveals that while 80 per cent of water consumption in India is attributable to irrigation (with almost three quarters being serviced through ground water), drinking water (for both rural as well as urban settlements) accounts for a distant 15 per cent of the overall consumption. Industrial use is marginally behind, and the rest is used for miscellaneous & other purposes. Several cities run the prospect of running out of viable groundwater sources within the next few years – many of them being key economic centres. Yet, despite such dire warnings – water resources – especially for drinking and other forms of human consumption - are still being managed on a largely piecemeal basis. Even States such as Uttar Pradesh, which have an abundance of perennial surface water sources such as rivers, often find it easier and expedient to utilize ground water as a cheaper and more easily provisioned source.

By any and all scientific estimates, and also for design considerations of water supply and wastewater treatment – about 80 per cent of water used for human consumption is regenerated in the form of wastewater. With certain forms of treatments, much of the resource can be re-used and recycled for other categories of use, without being dependent on abstraction from ground or surface sources. This realization has been around for a while, and while older programmes like JNNURM attempted to coax States and cities to create byelaws for reuse and recycle of treated wastewater, this has generally not been a resounding success – ostensibly due to the lack of a structured mechanism of carriage, distribution and pricing. Traditionally, pricing of treated water – which should ideally have been based on costs incurred less public subsidies that can be extended – have been a huge source of consternation as well as political debate. This has generally impeded appropriate pricing for drinking water, and by extension – reusable or recycled water for non-drinking or non-potable uses as well. Yet, there are excellent examples that exist to illustrate the viability of reuse and recycling – notably the reuse of wastewater feed from Nagpur's municipal wastewater treatment for turbine feedstock for a power station and the use of waste stabilization ponds to treat the water to a fairly usable level for irrigation before being discharged in canals. Over a period of time, as land rates increase, means such as waste stabilization ponds start losing economic viability for the amount of ground areas they consume – necessitating newer technologies such as membrane bio-reactors (MBR) or moving bed bio-reactors (MBBR) which consume far lesser space. However, it is often seen that municipal bodies – especially smaller ones, are constrained to exercise choice of such technologies.

In the State of Uttar Pradesh, for instance, the presence of a large catchment area of perennial rivers poses the possibility of usage or radial collector wells (Ranney wells) within or adjacent to the river bed as a sustainable alternative to conventional deep tube wells. However, these costs are significantly higher and are often overlooked in favor of using capital subsidy grants from Government of India for widening coverage as opposed to source sustainability.

Institutional arrangements

While a start has been made in the rural areas – which has - traditionally not been subject to structured and/or institutionalized water supply – with the incorporation of Village Water & Sanitation Committees to ensure universal coverage of water supply, it remains to be seen whether the institutional establishment for urban areas can be geared up to meet the challenge. As things stand, the near-stagnant coverage and reducing hours of supply have happened with the current institutional arrangements. The Constitution of India (74th Amendment) Act, 1992 accords the responsibility of ensuring water supply for domestic and industrial use to elected local self-Governments. In most cases, this clause of the law has been interpreted to treat elected local self-Governments as service providers as well as regulators.

However, this has also created situations where such elected local self-Governments cannot be held fully or institutionally accountable in terms of deficient service delivery – on account of the statutory monopoly that accrues to them through such institutional arrangement. Studies conducted in 2005-06 (UNDP) determined that institutionally, utilities with a singular focus on water supply & sanitation usually provide better value for money in terms of service quality & coverage. Globally – such services are provided by specialized service providers with local self-Government oversight and are dependent upon strong economic regulation. In turn, this has led to the fostering of an entire sector of business for private sector to provide water supply – akin to how electricity and power are now being addressed in India. In these sector, service delivery has been separated from regulation, and private sector participation is permitted through an apprpriate licensing model. As on date, these sectors exhibit a generally wider coverage in urban areas as compared to water & sanitation, despite not being treated as an essential part of "Right to Life" as enshrined in Article 21 of the Constitution.

Sustainability issues – keeping ODF that way

SBM-U has rightly been accredited as a significant game changer in terms of influencing habits pertaining to sanitation – notably the elimination of open defecation. While urban areas are generally deemed open defecation free, rural India is yet to achieve this milestone. Research into this aspect[2] indicates a slew of social issues – notably caste – as being a barrier to achieving the objectives of behavioral change.

Further, the mechanism used to determine the open-defecation free status of cities largely relies upon the evidence of open defecation as opposed to evidence of drivers that encourage sustenance of the practice. Past programmes – such as the Integrated Low Cost Sanitation – have indicated the potential of reverting to open defecation even after the provision of an on-premise toilet on account of improper provisioning of maintenance procedures. This risk runs high in community owned toilets where the onus of maintenance is upon community structures – which, without appropriate and formal measures can degenerate into a cycle of disrepair and disuse. A case in point is that of vermi-composting toilets, which have generally proven successful in low density areas – but whose maintenance requires the abhorrence/ avoidance of detergents and other acidic/basic reagents for cleaning of the toilet premises. In some cases, the very perception of cleanliness of toilets being dependent upon and synonymous with the use of commercial cleaning products caused these toilets to fail.

Issues also arise with improper provisioning of facilities for women, adolescent girls and children – where perceptions of safety can dissuade the use of toilets. This is often addressed through safety audits of low income and informal neighborhoods that support shared or community toilets, and selection of sites based on perceptions of safety as well as the provisioning of safety measures. If the local Government or community does not invest into these supplemental measures there remains the residual risk of reversion.

The law on prevention of manual scavenging has in recent times attempted to mechanize the entire process of cleaning sewers, minimizing, if not altogether removing human intervention.

However, this is often impeded by the paucity of appropriate safety gear. Some of the smaller municipal bodies attempt to bypass the obligation by appointment of third party contractors – who are generally held liable in case of loss of life during the cleaning of sewers and septic tanks. A system of accountability – similar to labor contracts – is not in place that determines the culpability of the municipal body or local authority that hires such a contractor that does not provision appropriate safety equipment.

2. Coffey. Dianne & Spears, Dan, "Where India Goes: Abandoned Toilets, Stunted Growth", 2017, Amazon India

The matter of faecal sludge treatment plants is generally seen as an end to end mechanism in cities that have a population of less than 1,00,000. However, research into sanitation practices at household level indicate that much of the problem of contamination of ground water stems from improper design of septic tanks – which are often fabricated locally with the objective of reducing the interval of evacuating as opposed to prevention of contamination of ground water. It is rather odd that IS:2470 (1986, revised 2013) – which governs the design and installation of septic tanks has till date concentrated exclusively on RCC containers, even when polymer products that are not only more durable, but also offer flexibility in shape (and has construction as well as operating standards in countries such as Australia, Ireland and Canada) are locally available in India. Research from EU nations also indicates that a certain degree of faecal sludge can be co-treated alongside normal sewage treatment plans (about 3 per cent of added volume, translates to about 20 per cent of a city's population) – but this is often disregarded in design considerations.

Also – a key issue remains that of manpower. Most local bodies cannot distinguish between civil engineering and public health engineering – with staffing being used interchangeably in terms of qualifications. In the longer run, this affects local Government performance in ensuring public health outcomes in the manner as would have been envisaged. Faecal sludge management – as a managed service is often partially or minimally regulated, limited

to licensing of such providers and penal provisions in case of unauthorized discharge/ dumping in non-designated drains. Evidence from NCT Delhi indicates that the work pressure(s) associated with these service providers as well as the support granted to them by way of evacuation (such as the discharge site being very distant from the service area) dissuade a proper and viable business model despite many States having developed regulations or municipal level byelaws for disposal of faecal sludge.

Big vs Small

Evidence from multiple cities in terms of solid waste management would seem to indicate the need for a robust approach in planning for the service. While integrated solid waste management – with a single vendor or service provider leading the entire value chain of collection, segregation, transport, treatment and disposal – remains the preferred mode of operation, examples from Southern India as well as cities such as Indore highlight the potential for multi-vendor, multi-stakeholder models that encourage the adoption of retail level best practices in waste management a lot better. Until a few years ago, a series of start-ups launched an 'e-Kabaadi' business, reclaiming recyclable waste from households through a mobile application. Unfortunately, with the absence of any kind of support from the State, many of these proponents attempted to meet the costs of logistics entirely by themselves – making expenditures on the business mismatched with the revenues from re-sale of recyclables.

Many cities have successfully developed compost from waste, but are now faced with the problem of plenty - where the local catchment for purchase of the products are often saturated. Smaller cities with a large rural catchment are often better positioned to address this issue with a more controlled outflow of by-products. However, this also opens the possibility of separating waste streams that allow for differential pipelines for different forms of waste – such as C&D waste being used for isolating rubble for admixtures for mass concrete, plastics for alternatives to bituminous admixtures for road laying, dry coconut shells for carbon fibre products and so on. These kinds of services can be conceived even at the MSME level, provided appropriate support is granted to reduce start-up/operating costs to begin with.

Possible options for the future

As urban India looks to move towards the next generation of WASH interventions, it will need to address gaps and create solutions which will help in not only sustaining the outcomes but also create a virtuous cycle of positive change across the WASH value chain. Key challenges and possible opportunities include:

Close Infrastructure and Services Gap for Water supply, ODF Sustainability and 100% ODF++: While over 99% Indian cities/towns have become ODF[3], the urban population is expected to significantly increase which will necessitate continued efforts towards providing access to sanitation. Therefore, to achieve 100% safe sanitation (with containment, transportation, treatment and potential reuse of treated wastewater), significant efforts will be required both on infrastructure as well as service provisioning. This, coupled, with institutional strengthening at the local level, will lead to increased efficiency and effectiveness when it comes to cities and towns demonstrating ODF sustainability. Similarly, the gap for household water connections is estimated to be 2.68 crores and that of sewer connections is 2.64 crore. Not only is it critical to create the required infrastructure to close this gap, but high quality O&M, and service provisioning will be key to its sustainability.

Strengthening Solid Waste Management: While many innovative and game-changing 'waste to wealth' policies have been introduced, it is critical to keep the momentum of Solid Waste Management (SWM) going along with streamlining the regulatory and legal framework for its effective implementation. The need of the hour is to further strengthen the recycling chain, bio-remediation of landfills for reclaiming valuable land, encouraging more decentralised and cost-effective waste processing solutions, and ensuring financial sustainability through collection of user charges.

Continued Behaviour Change Communication (BCC): A combination of high-visibility advocacy by the national leadership, close mentorship across various levels, multi-stakeholder involvement, massive outreach programmes, and national and provincial-level multimedia campaigns have resulted in creating near-universal awareness, while also inculcating a greater sense of ownership across communities giving it the shape of a people's movement. Going forward, in keeping with the philosophy of 'making WASH everyone's business', JJM-U and SBM-U 2.0 would need to reimagine its communication by beyond basic awareness raising and education, towards incentivising positive actions of citizens. There remains a huge scope to use newer principles (design thinking for behavior change communication), platforms (common-use digital platforms such as Vlog, influencer advertising, podcasts and interactive games) and partnerships (with private sector and other Ministries) along with traditional media to increase visibility and raise the decibel level for the country's urban sanitation discourse.

Scale up Private Enterprise Engagement Across the WASH Value Chain: Private sector in WASH has significantly scaled up in the past 5 years, not only through CSR contributions, but also through enterprise based models for areas such as public toilets, recycling & reuse, waste management, and decentralized water provisioning; apart from traditional PPP models for infrastructure. Going forward, there exists a large opportunity to leverage expertise and effective implementation approaches of private sector through debottlenecking of areas such as financing, procurement, credit and market linked incentives.

Participatory and Gender Inclusive Approaches: There has been significant improvement in inclusion aspects of WASH in the last phase of the Mission - several policy interventions such as protocols for sanitation workers' safety, guidance documents on gender responsive sanitation and parameters for women friendly sanitation facilities have been introduced by GOI. However, poor sanitation and inadequate water supply remains a cause for concern among vulnerable and marginalized communities (women, persons with disabilities, third gender, urban poor, etc.). Due considerations to gender, inclusion and equity concerns is an imperative not just at the city and state level but to also contribute to SDG's mandate of "Leaving No One Behind". This can be made possible through institutionalizing gender sensitization in policymaking across urban WASH, encouraging women and third gender- led enterprises/ entrepreneurs across the sanitation value chain and introducing gender and inclusion indicators in the national M&E framework to encourage state and city level equitable access amongst others.

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3.   Ministry of Housing & Urban Affairs, August 2019

Digital Tools for Capacity Building: The effectiveness of digital capacity building tools such as eLearning has been established, both in terms of cost effectiveness and potential to achieve scale with an investment of less than INR 50 million resulting in over 10 million certifications in less than 3 years. In the next phase, the digital capacity building ecosystem has the potential to be strengthened further through tools such as augmented reality-based exposure visits, AI enabled customized curricula on eLearning platform, courses delivered on common use platforms such as instant messaging platforms etc.

Analytics Enabled Decision Support Systems: One of the key pillars of SBM-U has been the creation of a comprehensive management information system with rich data not only through periodic collection, but also Swachh Survekshan and certification data from ODF/

ODF+/ODF++ and "star rating" assessments. Going forward, AI based analytical frameworks and tools within this system must be enabled to not only to support predictive, data driven decision making at the central government level, but also to support towns and cities in micro planning and monitoring WASH service delivery to residents.

While the first phase of SBM-U has firmly set India on the path towards sustainable sanitation, it is critical to acknowledge that this time spent is merely the tip of the iceberg. Going forward, for a country of India's size and diversity, the creation of an 'Atmanirbhar' (self-reliant) and 'Swachh (clean) India will only be possible through a multi-disciplinary, multi-stakeholder approach that prioritizes sustainable sanitation for all.

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6 Mobility in smart cities - an evolving perspective

The defining image of modern city life is a well lit night sky with vehicular lights criss crossing and billboards in start contrast through often dimly lit spaces that we inhabit.

Yet automobiles are the reason for a stressful u rban life. They create

- Pollution from fuel exhausts which kills 8 persons every hour in India[1]

- India's road accident fatality rate is one of the highest in the world of around one death every 3 minutes[2]

- Congestion leads to slower speeds and more pollution – a 10 km commute in Mumbai takes 37 min compared to 21 in Singapore[3]

1. Environmental Review, February 2021, University of Harvard.
2. National Crime Records Bureau, Ministry of Road Transport & Highway, Law commission of India, Global status report on Road Safety.
3. Report in Mint, 08 September 2019

Livability as the Goal of City Life

A benchmark of a high standard for modern city life is in the Quality of Life it offers, not only in terms of opportunities for employment and education but unpolluted environment, security and accessibility to leisure and entertainment facilities.

Highspeed expressways, focused on only faster movement by roads, tear apart residential neighborhoods in urban areas killing off its livability as a city. In 2017 the citizens of **Portland, Oregon** opposed tooth and nail the expansion of I-5 Highway. Several such movements have happened in the past including in India. It is seen that road widening to ease congestion doesn't work as wider roads are soon filled up with more automobiles.

Traffic Calming is a concept which has arisen out of this disenchantment with highways and freeways cutting through the city. Referring to the movements in the 1970's and 1980's in Europe to "recapture the streets" it is now a well-recognized tool to create better neighborhoods so that people can safely walk, stroll, bike, socialize, and go shopping rather than only experiencing the streets as conduits for vehicular traffic.
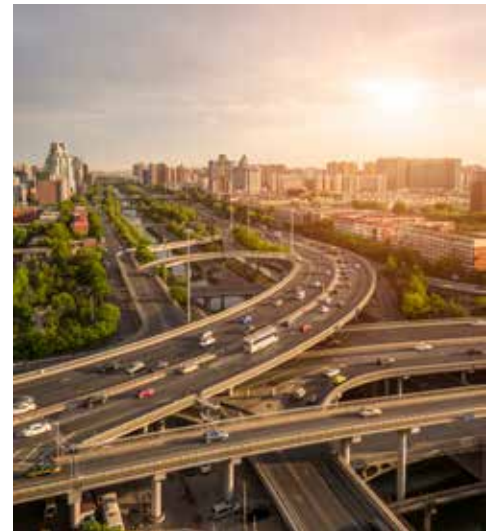
Highways are known to affect the quality of livability

Evolution of transportation system in the smart city

Smart City 1.0
(Upgrade current system of movement)

▶

Smart City 2.0
(Move People, Not Cars)

▶

Smart City 3.0
(Reducing travel need)

Transport for Smart City 1.0 – Improving the way we move now

Making roads efficient and safer

- Current smart city projects in India have introduced Artificial Intelligence enabled cameras to detect speeding and traffic light violations

- Additionally, roads and intersections are being re-designed to improve geometrics and reduce probability of accidents

- Segregation of low speed and high-speed Traffic to reduce accidents (cycle lanes and pedestrians vis-à-vis vehicular carriageways) is also being done.

Segregation of traffic

> **An advanced city is not one where even the poor use cars, but rather one where even the rich use public transport**
>
> **Enrique Penalosa**

Intelligent Traffic Management System

Many Smart Cities – such as Gwalior and Karnal are now developing Intelligent Traffic and Transport Systems.

In Karnal Area wide Traffic Control Systems (ATCS), a type of ITMS has been used which is a self-calibrating control solution that automatically adapts the timing of a traffic lights, based on real-time traffic conditions, to optimize the flow of traffic. It will result in substantially reduced burden on Traffic Police on the junction/intersection.
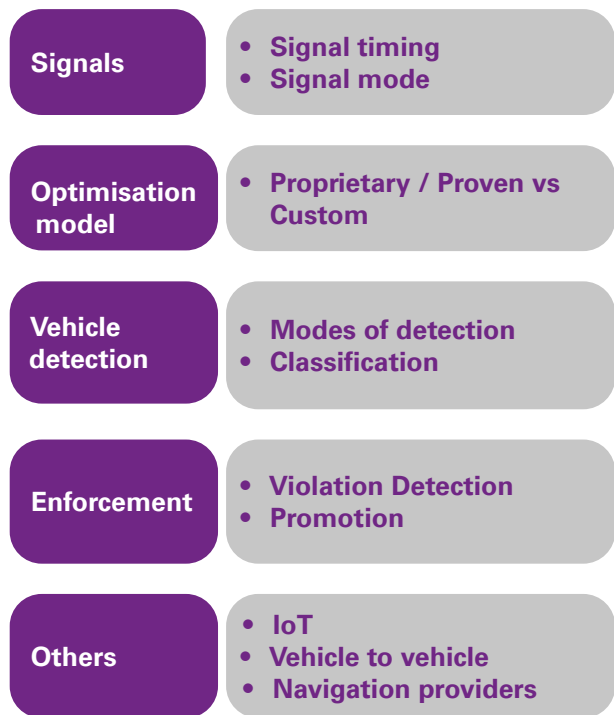
City Bus Services

Most larger cities have their own bus services – such as BEST (Mumbai), DTC (Delhi), BMRTC (Bengaluru), KSTC (Kolkata) and so on. However, smaller cities have typically relied upon the State Transport Corporations to run buses at the local level – which is often not found viable. The States of Madhya Pradesh and Chhattisgarh, for instance – closed down their State Transport Corporations in favor of city-based transport corporations – which oddly, work more on inter-city travel.

However, in emerging business centres like Navi Mumbai, there are opportunities to build public transport into the city's fabric from scratch or at least at the very formative stage.

The system at Navi Mumbai incorporates a wide range of 'smart alternatives', such as:

- Automatic Vehicle Location System (AVLS) for real time bus tracking, Knowing expected arrival time for buses and plan travel accordingly

- Automated Fare Collection System (AFCS)-For live route analysis by income, real time electronic fare collection system of buses for every 30 seconds

- Open loop multi transit "NAVI" card (A RuPay National Common Mobility Card (NCMC) card enables travelers in Mumbai to enjoy cashless commute in NMMT buses).

- Incident Management System to cater to all incidents reported including accidents, breakdowns etc.

- Command and Control Centre to track and monitor the fleet movement, fare collection, route violations, driving behavior etc. and take appropriate steps for mitigating any challenges or incidents

Signals	• Signal timing • Signal mode
Optimisation model	• Proprietary / Proven vs Custom
Vehicle detection	• Modes of detection • Classification
Enforcement	• Violation Detection • Promotion
Others	• IoT • Vehicle to vehicle • Navigation providers

ITMS components with functions

Bicycle Sharing

Bicycles are highly desirable modes for a city due to their non-polluting nature and for health benefits to the cycler. But bicycle sharing has not picked up pace mainly because absence of bicycles themselves and the fast pace of life.

In certain cases, such as in Delhi, the weather itself does not favour the usage of bicycles, while in cities in Uttar Pradesh, there is a general tendency to perceive cycles as socially and economically 'downmarket' – and dedicated cycle tracks, constructed in Lucknow and other cities – are often encroached upon. In terms of modal share, bicycles typically work best where average trip length does not exceed 3 to 5 kilometers.

However, public bicycle sharing is often preferred in EU cities as the only viable last mile for travel. In India, some of the cities that have received funding under the Smart Cities Mission have attempted to recreate this, notably Pimpri Chinchwad, Nashik and Gwalior. Some of the features there include:

- Installation & maintenance of 500-1000 cycles and 50-100 docking Stations requiring geo-fencing

- IT installations including mobile application

- Procurement & maintenance of state-of-the art bicycles carrying RFID chips which make them navigable from remote control stations of the operators

- Collect & reconcile fare based on the usage

- Conduct awareness campaigns for higher adoption.

- **Gwalior Smart City**
- **Pimpri Chinchwad Smart City**
- **Nashik Smart City**

Electric Vehicles

Electric vehicles have been around for more than a century now. Reduction of air pollution is a big benefit from Electric Vehicle usage as in India pollution annually kills around 12 lakh persons. Also it will reduce India's dependance on oil. According to the Niti Aayog, India's oil-import bill can be reduced by almos ₹1.2 lakh crore by 2025-26, by shifting the two-wheelers from petrol to electric.[1] This is impressive as it is twice India's annual budget on health care of around ₹63,000 crore. It is no wonder then that Govt. of India recently announced a goal to produce and sell only electric cars by 2030.

Volvo Group of Sweden – known as a manufacturer and supplier of buses all over the world, has carried out pioneering work on the case for electric buses by building environmental and social impacts into the total cost of ownership. The objective was to understand how the total cost of electric buses compares with that of diesel buses when social and environmental impacts are considered – commonly referred to as True Total Cost of Ownership.

This approach measures environmental and socioeconomic impacts of an organization and/or its products and services, i.e. quantifies them in financial terms.
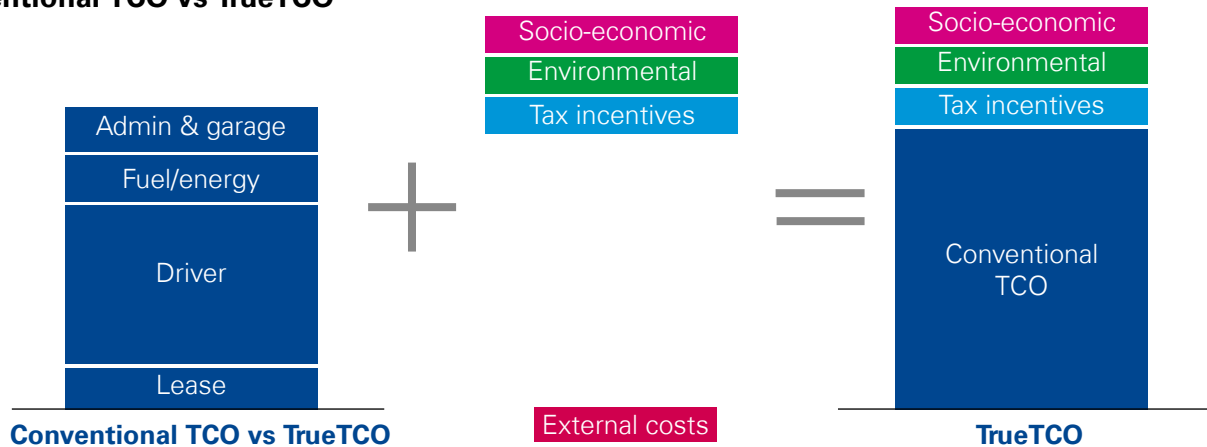
Electric Vehicle charging infrastructure

While existing policy measures represent a step in the right direction, there is scope for improvement if India is to create a conducive environment for EV adoption. Incentivization of customers and manufactures through both supply-side and demand-side incentives will be critical in addressing EV adoption barriers and expediting the transition to EVs.

Setting up of adequate charging infrastructure is key to encourage users to consider EVs. Most EV sales take place in lighter mobility categories, creating demand for charging infrastructure at homes/residences, parking lots, workplaces or commercial establishments. The state-level EV policies should focus on promoting these models of charging infrastructure.

The Indian government has sanctioned 2636 (public) charging stations in 62 cities across 24 states/UTs to be installed by 19 public entities.[2] Out of these, 1633 charging stations are expected to be fast charging stations, and 1003 slow charging stations. With this, ~20,000 charging points are expected to be installed across selected cities.

In summary, supportive policy, falling battery prices, charging infrastructure and supply chain localization are among the factors that need to come together to power growth for EVs.

4. NITI Aayog's 'Zero Emission Vehicles: Towards a Policy Framework', September 2018
5. Statement issued by Government of India announcing results under the "Faster Adoption & Manufacturing of Electric vehicles" of "FAME" scheme, phase II, January 2020

Conventional TCO vs TrueTCO

Conventional TCO vs TrueTCO		TrueTCO
Admin & garage	Socio-economic	Socio-economic
Fuel/energy	Environmental	Environmental
Driver	Tax incentives	Tax incentives
	+	=
Lease		Conventional TCO
Conventional TCO vs TrueTCO	External costs	**TrueTCO**

Transport for Smart City 2.0 - Move People, not vehicles

Need for Shift to Public Transport

Road space in a city is almost constant. But the number of vehicles keeps growing. Hence automobiles in the transport system, which creates the demand for road space, would one day outstrip the fixed supply. No doubt we see a steady decline in average road speeds in our cities.

Cars usually perform poorly as regards efficiency of transporting people as they have a limited capacity of no more than 600 to 1,600 persons per hour per direction.[6] Buses have a capacity of at least twice more. A Bus Rapid Transit System (BRTS) with dedicated lane/right of way would increase the capacity by another eight times up to 8,000 persons per hour per direction. But people tend to use cars as they are comfortable and appear to be safer than public transport. Hence it is imperative that we focus on providing comfortable, fast and safe public transport modes to effect the shift.

Amongst public transport, rail based mass transit systems are often positioned as the panacea for the urban transport chaos as it moves the masses for a long distance quickly (60,000 to 75,000 persons per hour per direction). Unfortunately, they are very costly to build (upwards 250 crore per km) and thereafter operate and maintain unless the city is bigger than a certain size and density.

Transit Oriented Development (TOD)

TOD integrates land use and high capacity transport corridors with an aim to having walkable and livable communes with high density mixed land use.

Government of India has released a Transit Oriented Development Policy in 2016. It promotes densification in the influence area by allowing for higher Floor Area Ratio (FAR) and higher population & job density compared to the area beyond its influence.

Under TOD, city densification will be promoted along mass transit corridors through vertical construction by substantially enhancing FARs (Floor Area Ratio). FAR may be increased by 3-5 times for residential pockets within the walking distances of bus stands and/or metro stations, thereby increasing public transport ridership.

Our cities and public spaces have unfortunately seen a reverse trend, wherein real estate and built spaces (development) have often been completed and only once operational, the need for connectivity and moving people in and out of those spaces (transit) comes up as a problem to solve - development first and transit planning later. This is slowly changing and planning, design firms are working closely with states, cities and implementing agencies to look at integrated transit oriented development across rail, metro and buses and other modes.

Transport for Smart City 3.0 - Why move at all?

This is an interesting proposition which we all can grasp intuitively as the basis of all transportation activity is the need to move from point A to B. But with technology that need seems to be steadily decreasing.

Connected anywhere

As the pandemic brought cities to a standstill the corporate world never missed a beat. Today we have a more connected world through video-conferencing based collaboration tools. In fact, corporations around the globe are planning to reduce their office space requirement permanently by allowing a large portion of their workforce from home. This will have a significant impact on the commuting needs of the working population.

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6. National Association of City Transportation Officials, https://nacto.org/publication/transit-street-design-guide/introduction/why/designing-move-people/

With advent of technology, the future of work of a lot of people seems to head home. Using holographic technology and better connectivity we could soon reach that situation where intercity and international travel will be redundant except for tourism.

Mixed land use development

Land use of new cities are often planned into distinctly demarcated parcels with pre-decided usage such as residential, commercial, industrial etc. It is often an endeavor of planners to keep them separate so that they don't interfere into each other's functioning. However, it is increasingly seen that this approach may not be ideal with creation of long commute hours between various land uses. Traditionally a residential and commercial mix of land use had been efficient in creating a lively urban atmosphere besides making long travel requirements redundant.

Decentralization of the city

In the same vein of mixed-use developments, having people travel from one end of the city to the other in search of work converts the city into a road. Mumbai is a prime example wherein the morning traffic rushes from north to south and the evening traffic rushes to the north. This is very inefficient as an urban planning model and is rightly being discouraged by construction of District Centres such as Bandra Kurla Complex as newer locations for employment spread through the city. This reduces the trip lengths considerably and overall load on the road system.

Neom – A city without Roads

Proposed to be built in the North Western part of Saudi Arabia, on the banks of Red Sea, it has officially been described as "The Line" as it is an agglomeration of livable communities spread over 170 km in length joined by a high speed transport corridor. The city, without cars and roads and built around nature would have 1 million residents and create 380,000 jobs by 2030.

Transportation from one end of The Line to the other will never take more than 20 minutes, according to Neom's developers.

Image sources

1. https://static.dezeen.com/uploads/2021/01/the-line-neom-saudi-arabia_dezeen_2364_col_0-2.jpg

2. https://www.zdnet.com/a/hub/i/2021/02/16/45ea6b8f-e365-4a25-a5b3-a8e0532f38d3/neom-3-layers.jpg

3. https://media.architecturaldigest.com/photos/600f076bad576d6ce2900767/16:9/w_2560%2Cc_limit/Screen%252520Shot%2525202021-01-23%252520at%2525205.12.53%252520PM.png
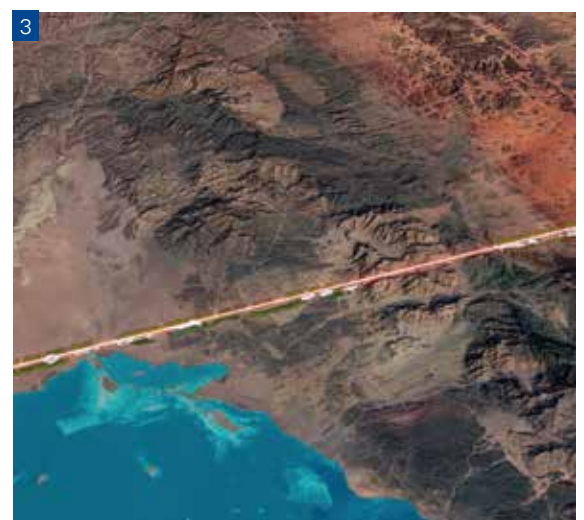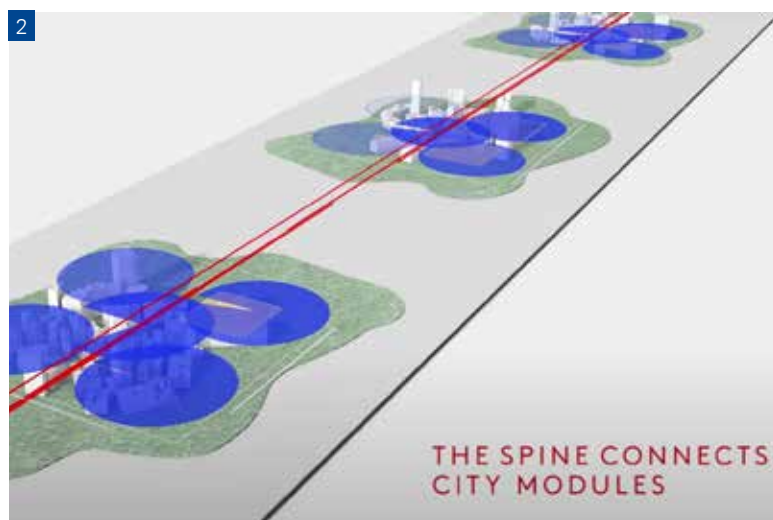
The Way Ahead – Driven by Technology

The disruption in the urban transportation usually first happens in the Technology space.

Augmented Reality, Virtual Reality (AR/VR)

It is said that the modern Jet plane is so automated that it can land itself. Likewise Cars are increasingly getting sophisticated. Cars are already fitted with computers to monitor every parameter of its operation. The focus is now to make some of it visible on the windscreen. For example, with extensive digital mapping of urban areas, the road boundaries can be projected on the screen to augment the driving experience. Night vision is another facility being attempted at.

Driverless Cars

In the next decade urban mobility will no longer depend on drivers. Both automobiles and Rail traffic have seen a significant progress in Driverless operations. With complete driverless operations and maturing of collision avoidance technology it is expected that Road accidents involving other vehicles and pedestrians will soon be a thing of the past. While this is liberating in many ways it may have a tremendous impact on our employment.

At sizeable portion of the blue-collar workers of India are employed as professional drivers, either for public transport, cargo, or private automobiles. Driverless technology therefore seems to be a crisis in the making for developing nations but just like computers and other technologies did, it is sure to arrive. The very fact that it can be predicted with some degree of surety makes it manageable only if appropriate steps are taken in time to rehabilitate these workers through re-skilling.

Air Taxis, Hyperloop and Hypersonic planes

The twenty-first century promises to be lot more exciting with radically new modes of transportation taking over.

Of these Air Taxis are already technically feasible and quite a few companies including Uber and Air Asia have announced launching them by 2024.

Hyperloop attempts to move and Hypersonic planes come with a lot of promise but mainly for intercity and intercontinental travel.

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Conclusion

In the next decade, new technologies are going to bring in a fundamental change in the ways we live, work and move

The smartness of a city is not just in managing how its traffic move well but not let it get on the road in the first place. This should ideally be achieved through incentivizing Public Transport and disincentivizing Private Transport. A high density of Public Transit network reduces the need to use private alternate mode if it provides adequate connectivity to all parts of the city. In case of disincentives, Electronic Road Pricing as implemented in Singapore and London, is a smart way to discourage private vehicles to enter the inner, congested city areas.

But the smartest approach is to create self-contained zones in the city. These zones will cater to most of the work, education, shopping and entertainment needs of the citizens by being accessible through use of non-motorised transport like a bicycle. Subsequently the need for travel through the entire length of the city would be reduced to a bare minimum, achievable through use of high speed public transit only.

7 Making Indian smart cities climate smart

Background

Climate change and climate induced disasters have emerged as a significant risk for Indian cities in the recent past. However, most of the Indian cities are still only focusing on coping with urban development challenges such as poverty, education and health. Given the pace of urbanization and the increasing climate impacts, the cities will have to learn to become increasingly climate resilient as well as economically sustainable.

India has witnessed several extreme weather events such as floods, heat waves and cyclones, with an unusual spike of about 310 extreme weather events between 2005 to 2019 (average 22 events per annum) from 250 events between 1970 to 2004 (7 events per annum). About 75%[1] of coastal districts (having 1/3rd population) in India are vulnerable to cyclones and coastal flooding events. Cyclonic events have observed a drastic shift in their intensity and frequency. In the year 2020, India not only witnessed two 'very severe' cyclones (Amphan and Nivar) on its eastern coast but also observed cyclone Nisarga on the western coast after about 70 years.[2] The increasing health impacts and deaths due to heat waves every year, especially in the states of Odisha, Telangana, and Andhra Pradesh,

has raised an alarming signal for revisiting urban development in Indian cities.

In 2019, India was ranked as the 7th worst affected country by climate change with a Global Climate Risk Index of 16.67 (the worst being 2). The country witnessed maximum number of deaths (2,267) globally and high economic losses (USD 68,812 million) due to climate triggered events.[3] The occurrence of such events and their impacts are only going to increase in the future, which if overlooked in our city planning practices are going to take a toll on cities' population health and infrastructure. Impacts of unplanned urbanization, lack of adequate climate resilient infrastructure, reduction in forests and natural ecosystems (lakes and wetlands) along with illegal encroachment on natural drainage systems have been evident at the time of extreme rainfall events and during flooding in Chennai (2015) and Kerala (2018).

Since these are not the only alarming events that have occurred in the past and will take place in the future as well, it is important that cities well integrate climate resilience and disaster management practices in order to prepare for future and to improve the quality of life of citizens.

> ❝
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> **One can see from space how the human race has changed the Earth. Nearly all of the available land has been cleared of forest and is now used for agriculture or urban development. The polar icecaps are shrinking and the desert areas are increasing. At night, the Earth is no longer dark, but large areas are lit up. All of this is evidence that human exploitation of the planet is reaching a critical limit. But human demands and expectations are ever-increasing. We cannot continue to pollute the atmosphere, poison the ocean and exhaust the land. There isn't any more available**
>
> **Stephen Hawking**
>
> ❞

1. Extreme weather impacts 75% of India's districts, Hindustan Times, 2020
2. Cyclones rise as climate change heats up Indian Ocean, India Climate Dialogue, 2020
3. https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_1.pdf

Current climate disconnect in indian smart cities

Many Indian cities have been severely impacted by climate change yet there is observed to be very little effort towards building climate resilience. Climate-induced hazards and their impacts such as rising temperature, air pollution, water stress, food shortages and health impacts due to spread of diseases may render the current infrastructure and services inadequate for future use and/or may require additional costs for retrofits and maintenance.

Even the current largest urban development programme running in India, i.e. the Smart City Mission has limited inclusion of development and implementation of climate smart solutions. The idea of a 'smart city' in India is skewed towards harnessing technologies and digital innovation to solve urban challenges, which is a considerably superficial veneer of resilience, rather than true flexibility and ability to handle large changes or shocks.

There is little focus on mainstreaming climate resilience and disaster management in the cities' planning practices right from policy development to infrastructure development. The environmental pillar which is crucial for addressing climate change and driving sustainable growth is currently severely missing. The most crucial climate risk, i.e. water stress that affects over 54% of the country and is at the same time severely impacted due to climate change is not considered from an environmental lens at the time of infrastructure planning and managing demand and supply in any city. Already, changes in rainfall patterns are beginning to affect discharges in surface water sources such as rivers, resulting in dry or low balance reservoirs etc.

While cities are obligated to ensure a certain quality and quantity of supply – with many cities now aiming for 24x7 supply (which contrary to popular belief, does not utilize more water), there is usually limited or no planning on ensuring source sustainability – such as ensuring that discharges into a surface water body (which later also doubles up as a source) are adequate in both quantity as well as quality. About 80 per cent of water consumed is also generated as wastewater. With certain forms of treatments, much of the resource can be re-used and recycled for other categories of use, without being dependent on abstraction from ground or surface sources. This realization has been around for a while, and while older programmes like JNNURM attempted to coax States and cities to create byelaws for reuse and recycle of treated wastewater, this has generally not been a resounding success – ostensibly due to the lack of a structured mechanism of carriage, distribution and pricing. With the predicted shortages in water availability in the future, much of the plans for supply of water in cities will be rendered unsustainable. The cities at the last hour will have to bear huge costs for managing infrastructure and sourcing more water for supply.

However, the question that arises here is whether cities are prepared technically and financially to bear the future impacts of climate change and disasters. The answer to this question is evident from the impacts we are currently facing especially at the time of extreme weather events.

Even though a few smart cities such as Chennai, Guwahati, Bhubaneswar and Vishakhapatnam focus on implementing measures for addressing natural disasters (such as installation of early warning systems), the planning of these measures is based solely on historical trends in occurrence of natural disasters and not forward looking, i.e. taking into account likely changes in future climatic conditions.[4]

Integrating climate change and disaster resilience

For integrating climate change and disaster management in current practices, a top-down as well as a bottoms-up approach will have to be followed. The policies, standards and benchmarks used for infrastructure design will need to be updated to include climate and disaster considerations. For example, building codes and design standards have an important role in making infrastructure resilient to impacts of extreme weather events such as increased heat, high intensity rainfall and floods. These could include changes in building elevation, foundation design, moisture entrapment and damage from debris.

Majority of Indian cities are currently in development phase therefore, the choices and decisions regarding their future urban forms are still open for India. This provides opportunities to select climate friendly pathways. The policies and standards should be revised based on detailed forward-looking scenario-based climate resilient approaches that will allow the decision-makers understand all possible changes and impacts that are likely to affect the cities and take a holistic, well-integrated decision.

While it is important to start from the top, inclusion of the bottom line of the stakeholder pyramid is also extremely important. For example, understanding and including local community needs and responses, their traditional knowledge and methods to make the plans and policies. The policies should also consider inclusion of ecosystem-based approaches that will significantly support communities adapt to the impacts of climate change as well as build resilience.
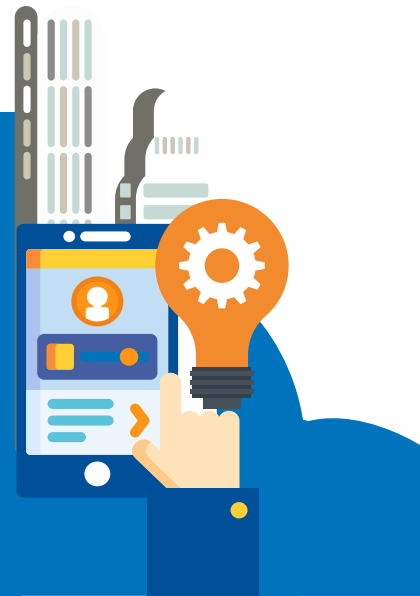
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4. Climate disconnect in India's smart city mission

8 Implementing smart cities – Challenges and lessons learnt

Background

The Smart Cities Mission was planned to help identified cities achieve certain parameters in quality of life, comprising of core infrastructure such as continuous availability of water, sanitation, power etc. coupled with a clean and sustainable environment, all of which would be powered by 'smart' solutions – usually enabled by information technology & data, effectively resulting in 'more' being generated from 'less'. To this extent, all cities that applied for grants under the Smart Cities Mission were expected to prepare a Smart City proposal – a pre-defined format offered by the Government of India that was meant to help structure a proposal in terms of narrative. This narrative would identify strengths, weaknesses, problem areas and opportunities for the city – and would eventually aim at evolving a pipeline of projects – that would be funded either out of the Smart Cities Mission, any of the allied schemes such as AMRUT, PMAY or any other Central sector or Centrally sponsored scheme, State funds and even private sector funds.

The bulk of the projects were expected to be in a pre-designated area, identified through extensive public consultation, which could be as small as barely 2 per cent of the municipal body's area of jurisdiction. For the remainder of the city – certain information technology enabled initiatives such as integrated command and control centers, intelligent traffic and transport management systems etc. could be included. The projects were meant to be implemented by a Special Purpose Vehicle – an entity created under the provisions of the Companies Act, 2013, with a 50 per cent ownership by the State Government, and the balance by the concerned municipal body, the funds for which was provided for by the Government of India. It may be noted that at no point was the Government of India ever part of the special purpose vehicle as a shareholder. It was clarified in 2016 itself that these special purpose vehicles would definitionally not be "Government Companies" as indicated in Section 2 (37) of the Companies Act, 2013, but would still be subject to audit by C&AG on account of most of the Board of Directors of the Company being ex-officio members, thereby indicating 'substantive control' by the Government (in this case, the State Government). Although the Companies Act, 2013 provides autonomy to the Board of Directors of a Company to take any and all decisions pertaining to usage of the company's capital, in many cases, the special purpose vehicle was granted certain limits in terms of physical (technical) sanction of projects as well as financial powers – that remained with higher offices within the State Government.

The special purpose vehicles are also generally 'lean' structures – with many cities not having appointing key management personnel for a long time, including women director, independent directors, a dedicated company secretary and a chief financial officer. In most cases, the Chief Executive Officer was a serving official of the State Government – often assigned the position as an additional responsibility. Incumbents to these positions have been regularly changed by means of transfer, and sporadic experiences of appointing professionals from the private sector have also not

> **" Plans are only good intentions unless they immediately degenerate into hard work**
>
> **Peter Drucker "**

been very successful. The guidelines also mention, as per para 4.1 and para 4.1.1 thereof, the obligation to delegate powers of the municipal body to the Chief Executive Officer and the power of the State Cabinet to the Board, subject to such provisions being present in law. However, as on date, no municipal law in any State permits the delegation of powers of a municipal body or even a State cabinet to a body corporate.

The lean structure of the special purpose vehicles implied that they would have to rely on outside entities – notably a project development and management consultant (PDMC) to help rationalize, develop and implement the projects through appropriate contractors. Usually, such PDMCs, that were appointed by these special purpose vehicles comprised of two consortium members – one specializing in engineering aspects of the physical infrastructure, the other specializing in design, development and roll-out of digital infrastructure. Some cities even 'split' their work packages to two or more contractors, and some – like the cities in Tamil Nadu, elected to appoint additional staff to the special purpose vehicles to carry out the work of the PDMC instead of hiring a company.

The implementation of various forms of projects over the last four years have yielded several interesting observations.

General challenges

Retrofitting existing legacy city infrastructure to make it smart

There are a number of latent issues to consider when reviewing a smart city strategy. The most important is to determine the existing city's weak areas that need utmost consideration, e.g. 100-per-cent distribution of water supply and sanitation. The integration of formerly isolated legacy systems to achieve citywide efficiencies can be a significant challenge.

Financing smart cities

The High-Power Expert Committee (HPEC) on Investment Estimates in Urban Infrastructure has assessed a per-capita investment cost (PCIC) of Rs 43,386 for a 20-year period. Using an average figure of 1 million people in each of the 100 smart cities, the total

estimate of investment requirements for the smart city comes to Rs 7 lakh crore over 20 years (with an annual escalation of 10 per cent from 2009-10 to 2014-15). This translates into an annual requirement of Rs 35,000 crore. One needs to see how these projects will be financed as the majority of project need would move through complete private investment or through PPPs (public-private partnership). As things stand, the extent of 'bankable' projects do not inspire confidence as regards securing public participation. Most cities have not utilized any funds apart from what have been made available under the Smart Cities Mission, other Centrally sponsored schemes and certain State sponsored schemes.

Availability of master plan or city development plan

Many cities don't have master plans or a city development plan, which is the key to smart city planning and implementation and encapsulates all a city needs to improve and provide better opportunities to its citizens. As per estimates received from T&CPO, about 60 per cent of statutory towns and 65 per cent of Census towns do not have one notified at present (2018).

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Financial sustainability of municipal bodies

Most municipal bodies are not financially self-sustainable and tariff levels fixed by the municipal for providing services such as water supply, wastewater treatment, solid waste management often do not mirror the cost of supplying the same. Even if additional investments are recovered in a phased manner, inadequate cost recovery will lead to continued financial losses.

Technical constraints of municipal bodies

Most municipal bodies have limited technical capacity to ensure timely and cost-effective implementation and subsequent operations and maintenance owing to limited recruitment over a number of years along with inability of the municipal bodies to attract best of talent at market competitive compensation rates.

Specific issues and constraints

Changes in projects listed under the smart city plan

Each of the identified cities targeted to receive funding under the Mission did so through the preparation of a Smart Cities Proposal in a pre-specified format. As most of the cities did not have the in-house ability to fill up these formats, this was left to a series of empaneled Consultants by the Ministry of (then) Urban Development. However, the time allowed for the preparation was usually not more than three months.

Furthermore, the proposals had to be accompanied by considerable public consultations spanning all sections of society. The crux of the proposal was the selection on an area within the city for deploying the bulk of the initiatives – also referred to in the guidelines as 'area-based development'. In many cases, selection of this area was done on general perceptions and public opinion, rather than preceding it with an assessment of how many of the characteristics of a smart city could be realistically taken up within such area. For instance, the idea of 'complete streets' along with 'smart' ducts within roads to organize services was proposed by almost every city that proposed to access funds. However, in many cases the basic geometry of the road was not conducive to take up such an effort. In at least one case, at-grade mass transit was proposed along a right of way that simply could not support such a feature.

While several smart city proposals were taken up based on the plans submitted, in many cases, once the funding was secured, it was found that many projects were fundamentally not feasible. This led to the concerned Smart Cities special purpose vehicles seeking completely new projects – many of which were not appropriately deliberated with the stakeholders.

In retrospect, several observers of the Smart Cities Mission programme have held the preparatory phase for the programme should have been longer – also allowing for better institutional arrangements and coordination.

Lack of projects that were technically or financially sustainable in the long term

In many cases, many projects that were conceived as part of a broader goal of sustainability were not accompanied by an assessment of whether such a project would be economically feasible in the first place. A typical example of this was the purchase of buses by several smart cities – many of which would eventually be diverted to inter-city travel, even though inter-city travel was not a significant part of trips generated within the city. In other cases, SCADA (Supervisory Control and Data Access) was deployed in water supply projects that did not statutorily support volumetric supply of water – defeating the larger purpose of keeping a tab on non-revenue water. Several cities invested into Smart Classrooms without a clear perspective on the long-term sustainability of the investment, often with limited and worse – with almost no understanding on learning outcomes.

Most projects of this nature require extensive preparatory activities. Deploying a new bus fleet, for instance, requires an extensive study of routes and their selection based on sound sampling – which can last months, if not a whole year. Likewise, projects in solid waste management – for efficient segregation, treatment & disposal – also require waste inventory studies that must be performed over a long period of time – and in a country like India – across multiple seasons. Most Smart City special purpose vehicles did not allow the luxury of time for these kinds of activities, resulting in piecemeal development of projects.

As smart cities continue to grow, experiences from the current set of cities should necessitate provision of adequate time and due diligence before formulating a project. In many cases, sampling periods for preparatory studies may take several months or even a year, in case seasonal variances need being accounted for. Further, many projects propose innovative models of public engagement that may take similar time with respect to consensus building.

Public participation in design of projects

Projects that involve usage and transformation of public spaces are usually meant to have a considerable level of deliberations with public representatives, and more importantly, the public at large. In the case of smart cities, pedestrianization of streets and stretches were done using writ of the law – typically a provision in most municipal laws that authorizes the Commissioner to deny access to vehicles on any given street or streets. While there are ample case studies available where pedestrianization has led to more 'living' streets, these examples have usually been accompanied by local Government patronage of activities to be carried out within such streets. In contrast, projects taken up in the 100 smart cities provided for limited interactions or deliberations with the public at large, with certain projects eventually having to be dropped as public was either disinterested or generally opposed to the project.

To be fair, India has the Street Vendors (Protection of Livelihoods & regulation of Street Vending) Act, 2014 to account for street vendors. However, the implementation of this law has been extremely patchy – and in most cases, completely disjointed from the creation of public spaces within streets. This is also coupled with provisions of the police act, which authorizes forcible clearance of streets in case of a perceived obstruction, with little or no say by the concerned municipal body. While the law insists on fostering of 'natural markets', some smart cities ended up moving vendors to less prominent areas, reducing patronage and business in the process.

Almost every municipal law has provisions for Ward Committees, *Mohalla Samiti's* and Wards' Committees (also called Zonal Committees in some States) – which are meant to provide public insights to both elected representatives as well as municipal functionaries. While the advent of social media was meant to have 'democratized' this space further, it has largely decimated such structured and established forums such as these – leading to a loss of connect between the municipal body and the public at large.
The issue of lack of communication has – by extension – also crept into the Smart Cities special purpose vehicle. This is further complicated by the understanding that the Board of Directors of the company has absolute discretion over the nature of projects – notwithstanding their very public nature. As a result, many projects – even after deployment – find less traction, or even opposition from the public at large.

Special purpose vehicles

The Smart Cities Mission was developed with the inherent provision of establishing a Smart Cities special purpose vehicle to carry out works in an expedient manner. The core idea behind this was the recognition of inherent inefficiencies within the public procurement & implementation processes and the ability to evolve a more efficient system thereof. To give it commensurate powers, it was also suggested in the guidelines (para 4.1 and 4.1.1) that the special purpose vehicles would be accorded, subject to the municipal laws of the State, the power of the municipal body as well as the power of the State cabinet within its areas of jurisdiction. Apart from the predictable question regarding the erosion of mandate of elected local Governments in line with the 74th Amendment, in nearly every case, this was legally not feasible as municipal laws do not provide for the delegation of powers to an body corporate that is not a Government company per se. The matter of financial autonomy and streamlined procurement is also impeded as the office of the C&AG eventually treated these special purpose vehicles not as Government companies, but still under substantive control of the Government (on account of the fact that over 90 per cent of the Board members are ex-officio) – thereby diminishing chances of using a more optimized procurement model.

The special purpose vehicle was meant to be set up as a private company with only 50 per cent being contributed by the State Government (the Ministry of Corporate Affairs has clarified that municipal shareholding cannot be held at par with Central and/or State Governments in line with section 2 (37) of Companies Act, 2013). It was clarified by the Government of India that all decision-making powers would remain with the Board of Directors of the Company. However, for all instances where projects were being taken up on land that belonged to the State or municipal body, there appears to be a lack of a formal transactional arrangement – blurring the roles between an 'owner' of a project, and its 'agent'. This has been seen in most cases where there have

been projects proposed that capitalize land(s) held with municipal bodies or the State, where the locus standi of the special purpose vehicle is often not clear. Simply transferring such lands to the special purpose vehicle is tantamount to write-off of the asset from the State or municipal register including any future revenues from the same, also entailing a major capital gains tax overhead for the special purpose vehicle. If it is simply vested with the special purpose vehicle for capitalization, the special purpose vehicle has little or no stake in the matter, as dividend from the venture would accrue to the agency that owns the land. In most cases, the assets created by the Smart City SPV will eventually revert to the municipal body or the State. If this happens while the SPV is still existing, this will essentially cause an asset-liability mismatch.

A similar issue appears to have shown up with the plethora of Integrated Command and Control Centres that have come up or are coming up in each city that has received funding under the Mission. Although the Smart Cities Mission funds are proposed to cover the capital and operating costs for up to five years, almost no city has developed a plan of sustenance after the funding and duration of operations lapses. Globally, ICCCs operate on a concession model, being paid from cumulative savings incurred by the line Departments by way of the information and services rendered by it. Thus far, no such arrangement appears to be in place. As things stand, there are no long-term revenue streams that appear to be accruing to the special purpose vehicles.

The lessons learnt from the Special Purpose Vehicles would seem to indicate that these have not worked in the manner on which they were originally intended. For one, these companies were created as a pre-condition to access funds under the Mission, but the Government of India held no equity in them – essentially making what should have been a voluntary move into a mandatory one. Some States, which have since attempted to create their own take on Smart Cities – this time as a State scheme – have simply not co-opted the idea.

A possible option could have been to vest the monies received from the Mission, other schemes, private sector bodies in the form of a trust. While assets could still be created, it would not have the matter of 'asset-liability' mismatch. The assets would remain property of the Trust (as per Trust law in India, assets vested with a Trust cannot be sold or divested), while operations and management would remain in the hands of the respective agencies or their delegates. This would also resolve the issue of the lack of participation from the elected representatives as they would not be seen as holding an "office of profit". Trusts could also be listed under Section 137, Schedule VII of the Companies Act, 2013, as being authorized recipients of funds as part of Corporate Social Responsibility, as well as potential grantees under Foreign Contributions Regulation Act, 2010 as well as donations attracting Section 80G of the Income Tax Act, 1961.

Reliance on Project Development and Management Consultants

Special purpose vehicles under the Smart Cities Mission were created as 'lean entities' - with only key management personnel being hired/ deputed in most cases. For conduct of the actual business of the companies, i.e. development of projects, it had been provisioned within the scheme guidelines itself to appoint project development and management consultants (PDMCs). By default, these consultants were meant to address all tasks of the SPV ranging from conceptualizing the projects, creating detailed project reports and other preparatory studies, and also engaging in supervision during the construction process. In essence, the PDMC was meant to be an extended arm of the SPV itself. The fees to the PDMCs are typically payable from the provisions for administrative and other expenses (A&OE) budget, which is 'carved out' of the allowance of INR 1,000 crore that each city receives, as an A&OE budget. In traditional DPR terms, this works out to roughly about 1.5 to 2.5 per cent of the project costs – but only when the intent and conditions precedent to carry out the project have been established and firmed up. In this instance, as indicated above, a lot of the projects that were placed as part of the Smart Cities

Proposal were found to be unviable or infeasible – thereby adding the burden of conceptualizing substitute projects from scratch. In many cases, this needed domain expertise that was not originally sought in the requests for proposals for appointment of the PDMCs. Furthermore – most of these contracts were lumpsum contracts dependent upon time and material inputs, which meant that services of domain experts not originally envisaged would be hard to provision in many cases. In a few cases, the percentage model was used, but with several projects being rendered infeasible based on ground realities, this also became an unviable model to work with.

The larger issue is that typically, design and pre-operative costs are treated as part of the project costs and not as administrative and other expenses – and could go even up to 10 per cent thereof – considering the task of conceptualizing and determination of feasibility projects in the first place. Transaction advisory services typically tend to cost more in the general market as compared to general management consultancies, therefore approximating the same within the PDMC on a limited budget was fraught with issues. Furthermore, most PDMCs provide only advisory services – which would mean that the special purpose vehicle would still have to appoint its own staff to vet and sign off on the work of the PDMCs. These resources were often unavailable or available only on a part-time/ shared basis with the municipal body, with many such personnel unfamiliar with forms of contracts other than works, resulting in delays and uncertainty over signing off on projects.

With information technology projects – there is a regular IEEE protocol that is followed in most software & hardware centric projects that involve supply, installation, testing and commissioning of the system, followed by five years of maintenance thereof. Vendors may or may not be adequately skilled to operate the system – a problem that showed up in some of the integrated command and control centers as the operating entity was often separate from the developer entity. Most PDMCs followed this model on account of the funding available – that favored an asset purchase

model as opposed to a concession model.

For future programmes, it would be advisable to structure the role of the entities. While a lean structure is welcome, a new mechanism is now available through portals such as Government e-Marketplace (GEM) that allow co-employment or payroll outsourcing – which prevent staff from being considered on the books of accounts of the soliciting party, and yet be treated as staff thereof. Separate and sequential contracts should be made with respect to feasibility and consensus building for projects and for DSM (design and supervision monitoring) and transaction advisory contracts. Key to such an arrangement would be the institution of highly qualified key management personnel within the special purpose vehicle who hold exclusive charge of the institution and who are not transferred or shifted for any reason other than poor performance. The number of skillsets required to conceptualize and develop projects are also not fixed and should be seen as part of project costs as opposed to administrative and other expenses as it is seen at present.

Contractors, vendors and the supplier ecosystem

A persistent issue which showed up during the implementation of many projects was the paucity of a well-developed system of contractors and vendors. In the case of civil construction (works) projects, most cities stuck to their regular contractors who have been associated with the concerned municipal bodies for their usual form(s) of works. However, for more complex projects – especially those with design-build-operate models for facilities or information technology based projects – smaller cities and towns often lost out to the larger ones – since the vendors were generally not interested or motivated to bid for the smaller towns.

Some States attempted to work around this problem by creating 'cluster' contracts that would make it mandatory for vendors to work across a cluster of cities. Projects such as Integrated Command and Control Centers – that work largely in the same manner in any city – have been taken up in this manner – but only where the State has multiple cities receiving
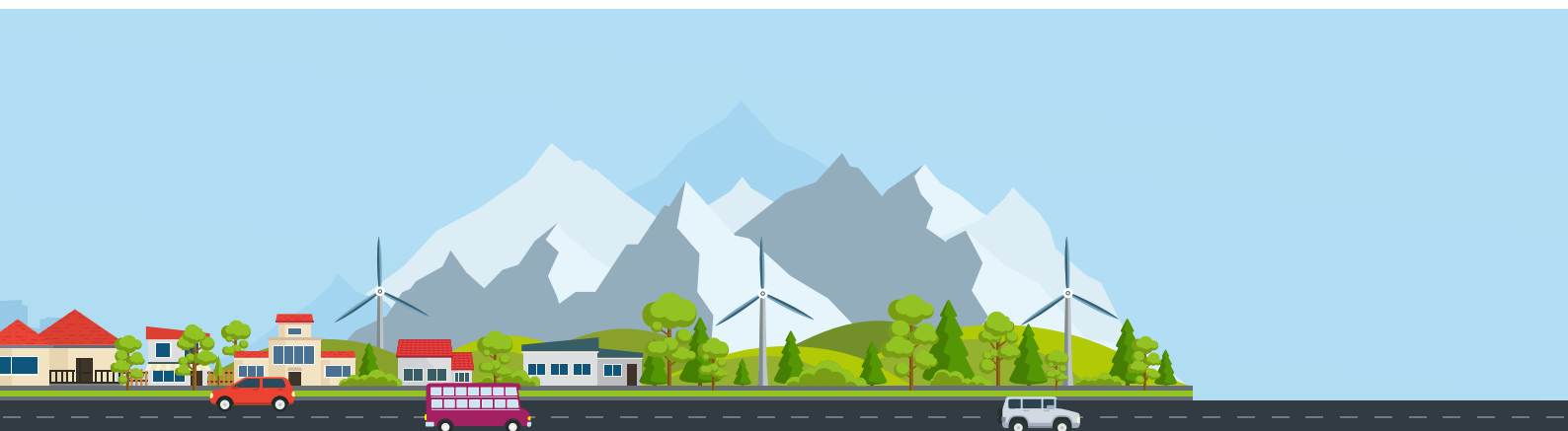
grants under the Mission. In the case of works as well, projects such as the installation of 'smart poles' has been taken up in this manner. In these cases, the State coordinates between the different cities to ensure that lessons/ successful instances of procurement are 'extended' to other cities within the same State, reducing procurement lead time. In others – monies may be pooled together to pay one single vendor who is working in multiple cities, in proportion to the amount of work that may be apportioned between the cities.

Despite the Government of India and State Governments having engaged in progressive reforms over the last few years, procurement remains a key challenge. As described previously, as Companies – the special purpose vehicles are empowered to have their own procurement statutes, generally compliant with appropriate GAAP protocols. However, the fact that about 90 per cent of the Board members of the special purpose vehicles are ex-officio members, State finance and accounts rules were adopted de-facto, even when there was no 'de-jure' reason to do so. This has also slowed down procurements in many places. Historically, evidence from externally added projects – such as those financed by the World Bank group, the Asian Development Bank etc. – where there is a condition in the debt covenant that mandates the use of FIDIC contracts irrespective of country specific or sub-National laws to the contrary – shows better participation by bidders as opposed to the State sanctioned contracts and standard bidding documents are used.

Curiously – in many cases such as establishment of health kiosks etc. where there was really no 'transaction' per se, many cities decided to engage in long processes such as calling for expression of interest and 'bids' – even though (a) there was no transaction to be made, and (b) there was no exclusivity in terms of provision of the service, such as vendor B not being allowed if vendor A is already in place.

Slow pace of implementation

This has been a standing issue with the Smart Cities Mission ever since the programme commenced. Even as late as February 2021, the parliamentary standing committee on urban development has flagged slow pace of projects within the Smart City Mission, noting that most of projects under it are either at tendered or grounded stage even after five years. Although the pace has picked up in the recent years, notwithstanding the slowdown caused by the lockdown, only about 18 per cent of the sanctioned value of the projects have been completed. As per the quarter ending 31 December 2020, a total of 5,151 projects worth INR 2,05,018 crore were grounded, but only 2,189 projects worth INR 35,457 crore were completed.

Although issues in project preparatory stage have been stated as a concern above, issues in implementation stage have been no less instrumental. Some projects require clearances by statutory authorities such as Archeological Survey of India as well as third parties (NOC), and in some cases, ground realities were found to be quite different from what was specified in the detailed project reports – notably the extents of land ownership in projects that involved widening and creation of new utilities ducts.

In some cases, designs produced by the PDMC or allied vendors took considerable time in being approved by the special purpose vehicle, and in some cases – by the State Government, which for some reasons – restricted the power of technical sanction to projects to a very small amount at the level of the special purpose vehicle. This was influenced by the procedure often used by public works departments – where works above a certain value or complexity are accorded technical sanction by a superior level within the Government. In this case, despite the level of autonomy provided to the SPV in line with the provisions of Companies Act, 2013, the adoption of this kind of sanction process delayed the implementation by a considerable time.

Cooperation from other departments and line utilities has also caused delays at the level of implementation. In conventional terms, the agency that undertakes the work that requires shifting of utilities such as power, gas, water and/or telecommunication lines also factors the costs of such shifting within the overall costs of the projects. However, the work has to be carried out by the concerned agency that owns the asset(s) in the first place. This is where a number of cases pertaining to delays have taken place – usually on account of poor coordination, planning approvals within the partner agency, unsuitability of the replacement site and so on. Future instances should consider the establishment of an inter-Departmental entity or mechanism that allows for anticipation, identification & resolution of these kinds of impediments/ bottlenecks as well as defined partnerships at the project development stage itself. In some places, where the SPV is headed by the Collector/ District Magistrate of the concerned district maintained a similar mechanism comprising of all senior officials of the district. This has achieved a certain degree of success, but is still largely ad-hoc and unstructured. It can be formalized through the trust model with an appropriately structured inter-departmental contracts/ contractual arrangements.

Conclusion

However, even though with several operational challenges – the general consensus amongst stakeholders such as the Government of India and the State Governments is that Smart Cities are here to stay, and what has been witnessed during the last five years is essentially just one iteration of how a programme of this magnitude and proportions can be implemented. It pays to bear in mind that even after nearly thirty years since the enactment Constitution of India (74th Amendment) Act, 1992 – municipal bodies are yet to receive complete autonomy in terms of fund, functions & functionality. Exposure to a new form of governance, adoption of technology etc. will take time to internalize, but it should be considerably faster – given the fact that a good number of local Government functionaries are within the younger segment of our workforce.

The public at large will also eventually start partaking increasingly into the processes associated with a 'smart city' – as and how the governance gets increasingly demystified, as will other stakeholders such as community-based organizations, civil society groups and such other active participants. Lastly – one of the most expected shifts in paradigms that is expected to come up in the next generation of smart cities is the co-opting of businesses into the technology layer. Already, some cities – such as Kakinada (Andhra Pradesh) are beginning to show results as different service providers are finding newer ways and means to do business in the city, building upon the smart elements and its allied ecosystem – putting it ahead of many other cities in its size class in terms of economic vibrancy.

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