India's Smart City Program: Challenges and Opportunities

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Abstract

India launched its National Smart Cities Mission (SCM) in 2015 with the goal of transforming urban areas into more inclusive, sustainable environments. The program was a response to the needs of a rapidly urbanizing population which requires a radical transformation of the built environment in order to realize a more prosperous and egalitarian society. A total tendered amount of 1.84 lakh crore (24.6 billion USD) has been approved under the project, with new developments receiving funding across the country. However, the SCM has so far failed to live up to its promise in a number of respects. It has disbursed its funding through a grant structure at odds with a national strategic vision for smart urbanization. Furthermore, by stretching the definition of "smart cities" nearly beyond recognition, it has become a catch-all umbrella for new government funding to urban projects, rather than a push to make India's cities digitized and more sustainable. This raises the question of whether it is appropriate for India to invest in smart cities right now, or whether this funding should instead go towards expanding the systems which provide essential basic services to the population first. Fortunately, the vision for the SCM can be modified in a way that new investments made under the program both meet the existing needs of the population and start building the foundation for a smarter, 21st century infrastructure. Indeed, this is necessary if the SCM and future urban development projects are to yield concrete benefits proportional to their costs.

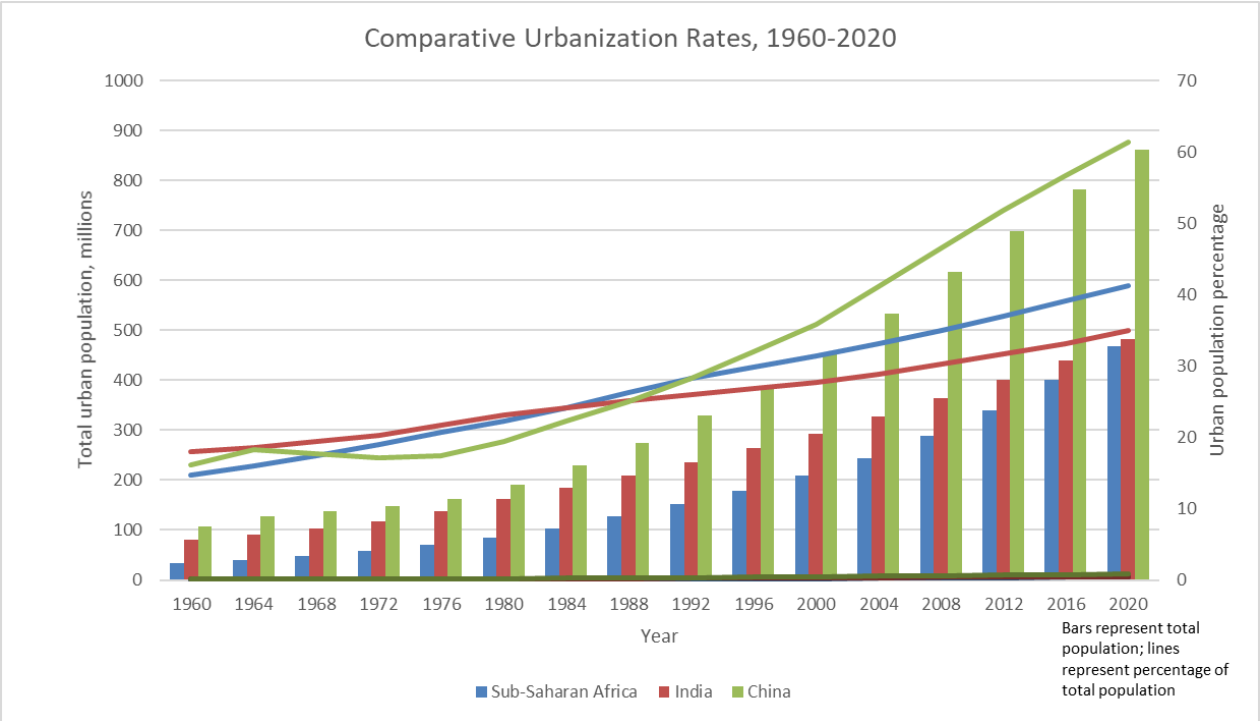
Introduction

Smart Cities and Sustainable Development

Since the middle of the 20th century, the world has experienced a wave of urbanization unprecedented in the history of mankind. As economic opportunities become increasingly centered in urban areas and mobility increases between cities and the countryside, billions of people now make their homes within vast agglomerations whose size could scarcely have been imagined as recently as a century ago. Since 1950 alone, the global urban population has risen from 751 million to 4.5 billion, and will likely reach 5.2 billion by 2030. This constitutes a near doubling of the global urbanization rate since 1950, from 30% to 57% today and an estimated 60% by 2030. The number of people living in cities today already exceeds the global population in 1980, and the urban population in 2030 will surpass the global population in 1990.

Urbanization has accelerated in every part of the world, but nowhere has it unfolded faster than in Asia, where the urban share of the population has tripled from 17.5% to 51.1% since 1950.[1] Within Asia, India is likely to make the greatest contribution to this growing urban population over the coming decades. Since 1950, the number of Indians living in cities has grown nearly eightfold, from 62 million to 482 million, while the overall urbanization rate has doubled from 17.3% to 35%. Population growth is expected to continue until just before 2050, and an ongoing evolution away from the agriculture sector and towards manufacturing and services will coincide with this growth, pulling a larger share of the population into cities in a fashion similar to what China witnessed from 1980 onwards. In the coming decades, Sub-Saharan Africa will likely be the only region to add a greater number of urban residents to global totals than India, largely due to that region's higher population growth rates. As soon as 2030, urban areas are expected to house 40% of the Indian population and be responsible for 75% of national GDP. The GOI estimates that handling India's urban expansion efficiently could add as much as 1.5% annually to the country's GDP.

[1] UN Population Division



With a high population, a shifting economy and an urbanization rate with plenty of room to rise, India will become one of the largest contributors to the world's urban population over the coming decades, matched only by India and surpassed only by Sub-Saharan Africa. Source: World Bank.

With cities increasingly serving as the stage upon which people from all backgrounds lead their lives, the condition of cities is becoming increasingly relevant to the overall prospects of achieving sustainable development. Urban residents often maintain higher living standards than their rural counterparts, placing pressure on society and the environment to meet their increasing demands. At the same time, however, resources can be delivered more efficiently to people residing in high population density landscapes, meaning city life has the potential to be more efficient and sustainable than alternatives. Navigating this balance will be a key challenge for urban planners and policymakers in the 21st century, one outlined in detail in the UN's Sustainable Development Goals. SDG 11 calls on UN member states to make cities inclusive, safe, resilient and sustainable by 2030, featuring targets for measuring this achievement including improving access to affordable housing, expanding public transit systems, improving resiliency to disasters, and ameliorating air and water pollution from unsustainable energy and waste disposal practices.

In recent years, the rise of so-called "smart cities" has presented an opportunity to accelerate these trends towards prosperous, inclusive sustainability. Smart cities embed advances in digital technology into every aspect of their infrastructure, leveraging Information and Communications Technology (ICT) to the fullest extent possible to shape the urban landscape into a dynamic, continuously adapting system in which demands for all types of resources are analyzed and responded to in real time. For instance, smart cities could autonomously react to high ridership on a transit system by instantaneously dispatching more vehicles or directing users to take alternative routes, or they could interface with utility providers to better match demand for power

and water to delivered supply at any given moment. Implemented properly, smart cities hold the potential to reduce waste, improve the efficiency and equity of service delivery for urban residents, and accelerate investments towards environmental protection. In the push and pull of forces determining what global urbanization will mean for the future, smart cities will likely make a great contribution to the causes of economic mobility, social opportunity, and overall sustainability.[2]

However, smart cities are no magic bullet. While their underlying technology does to some degree contribute to sustainability by improving resource use efficiency, it does so in a way that increases the throughput of that to which it is applied. As a result, smart city technology has a tendency to reinforce existing systems, which may or may not be sustainable at the scales required for today's rapidly growing urban areas. For example, cities which invest in making their roads more easily navigable for autonomous vehicles may temporarily experience slight traffic improvements and reduced emissions, but this will induce demand for heavier reliance on personal vehicles in the future, a form of transport which is fundamentally incompatible with the population density required for a sustainable urban area. Furthermore, smart technologies will not be utilized to their full potential unless they are embedded within a mutually reinforcing system of data collection and responsive optimization, which itself requires a great degree of invisible investment as well as safeguards before it is released for the benefit of the general public. Therefore, policymakers wishing to introduce smart city innovations should first ask whether the form of infrastructure they are hoping to bolster is intrinsically sustainable, especially under the burden of the higher urban populations that are all but inevitable for the future. They should then consider investing in a broader digital ecosystem for their city, rather than a standalone intervention which provides little opportunity for synergies or external benefit.

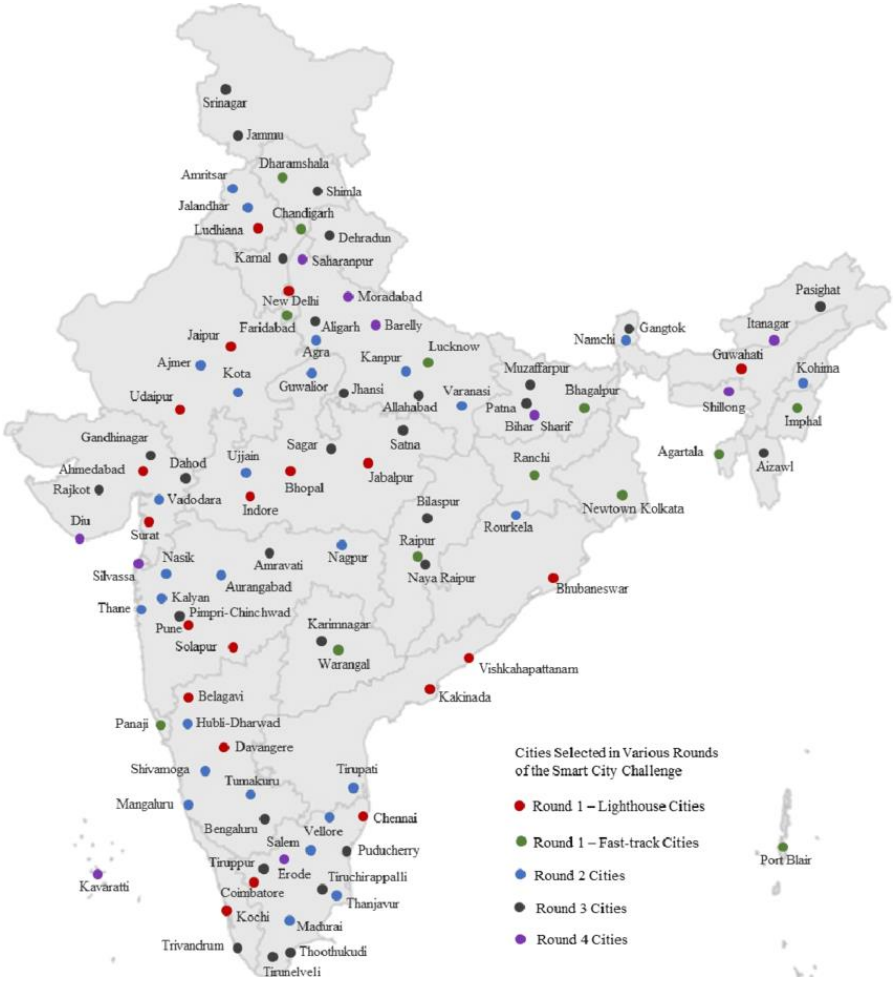
India's Smart Cities Mission: Motivation, Design and Outcomes

Faced with a future of continuing urban growth, challenges across the spectrum of sustainable development, and increasing pressure on existing cities to deliver opportunity and quality of life to their residents, the Government of India (GOI) under PM Narendra Modi launched the National Smart Cities Mission (NSCM) on June 25, 2015. With an initial funding level of 48,000 crore INR (6.4 billion USD) over five years, a total of 100 cities were selected to take part in the NSCM. Cities which complete their projects are intended to serve as demonstrative examples for their peers of the power of incorporating smart city innovations. Ultimately, the success of these pilot projects is intended to spark a wave of public-private investment in further development of smart cities without the need for direct intervention from the central government. To this point, the NSCM has sparked a total of 1.84 lakh crore INR (24.6 billion USD) in tendered investment from both public and private circles for its projects across the country.

India's cities currently rank low in indices of development and sustainability, which the SCM has in part been intended to address. In 2019, IESE Business School created a global ranking of

[2] For further discussion regarding the development of smart cities, please review the working paper "Best Practices for Sustainable Smart Cities," available at https://csd.columbia.edu/sites/default/files/content/docs/ICT%20India/Papers/ICT_India_Working_Paper_57.pdf .

174 cities by "smartness," which incorporated indicators for human capital, social cohesion, economic prosperity, governance, environment, mobility, urban planning, international outreach, and technology. Indian cities ranked between 153 for Bengaluru and 169 for Kolkata, with Mumbai and Delhi falling in between. Only Douala, Lagos, Caracas, Lahore, and Karachi ranked lower in the index, demonstrating the continuing challenges Indian cities face not just in becoming the hubs of technological governance envisioned by the SCM, but even in delivering basic services to all their residents.



Cities were selected on a competitive basis annually across the country for inclusion in the NSCM, for a total of 100 over five years. With projects intended to last three years, completion has been scheduled between 2019 and 2023. Source: Praharaj, Sarbeswar.

Cities were invited to submit proposals for a minimum of two projects through the NSCM. The first would be an area-based development project in which an existing location was retrofitted or redeveloped, as a way of providing a "lighthouse," or a best practice model, to other parts of the city. The second would be a city-wide development project, aimed at impacting the entire population. Projects submitted under this guideline typically included city-wide ICT networks with the specific aim of improving monitoring of urban functions such as public safety, energy

usage, transit and traffic, or environmental conditions. To aid participants in developing their vision for a smart city, the Ministry of Housing and Urban Affairs (MoHUA) issued guidelines which encouraged cities to design projects promoting mixed land use, inclusive housing, walkable communities, open space, multimodal transport, transparent and responsive governance, and strengthening local identity, while applying "Smart Solutions" to these challenges to the fullest extent possible. Yet the MoHUA did not define what a smart city should be, offering cities infinite latitude to create their own definitions of "smartness" and design projects that applied to them. In the Ministry's reference note to MPs, Smart Cities were not defined by any reference to ICT or sustainability, but simply as "those that are able to attract investments."

Participating cities were selected through a "Smart Cities Challenge," developed and conducted by the GOI in partnership with Bloomberg Philanthropies. A city assessment, given a 30% weight within the evaluation, examined each Urban Local Body's (ULB) performance on metrics such as administrative and operational efficiency, and executed an appraisal of each city's overall urban strategic vision, the sustainability and inclusiveness of this vision, and its plans for incorporating ICT into the urban landscape. On the other hand, a proposal-level evaluation, weighted at 70%, examined the merits of each city's proposals on dimensions such as cost-effectiveness, feasibility, innovation, scalability, and citizen engagement. Cities first competed against peers at the state level, after which state governments submitted nominees for inclusion to the national government. The 33 highest performing cities were chosen to participate in the first round, with other applicants invited to revise and resubmit their invitations annually until the total number of participating cities reached 100 by the final round. As a result of this process, cities have been chosen to participate in the NSCM from every single State and Union Territory in the country, with the exception of the newly formed Ladakh UT. The selected cities are collectively home to roughly 35% of India's urban population, or around 130 million people.

Once a city was chosen for NSCM inclusion through this competitive process, it was required to set up a Special Purpose Vehicle (SPV) to coordinate financing and implementation of the proposed projects. SPVs were required to place their majority holdings in the hands of government bodies, with the stake of private investors limited to 40%. As a condition of receiving seed funding from the GOI, and matching funding from state governments, the SPV would be required to obtain the remainder of the funding for its projects via other means. Through this funding structure, an average of 200 crore INR (26.7 million USD) was allocated per city per year through public means, amounting to just under half of the funding requirement for all projects. However, the funding requirements varied widely between cities, from a 500 crore INR budget in Lakshadweep to a 6000 crore INR budget in Chandigarh. With uniform funding budgeted for all cities regardless of their position within the mission, the remainder of the cost was recovered through municipal bonds issued on the financial markets, land use conversion charges, user fees, synergies with other government programs, sale of government assets, and corporate CSR initiatives.

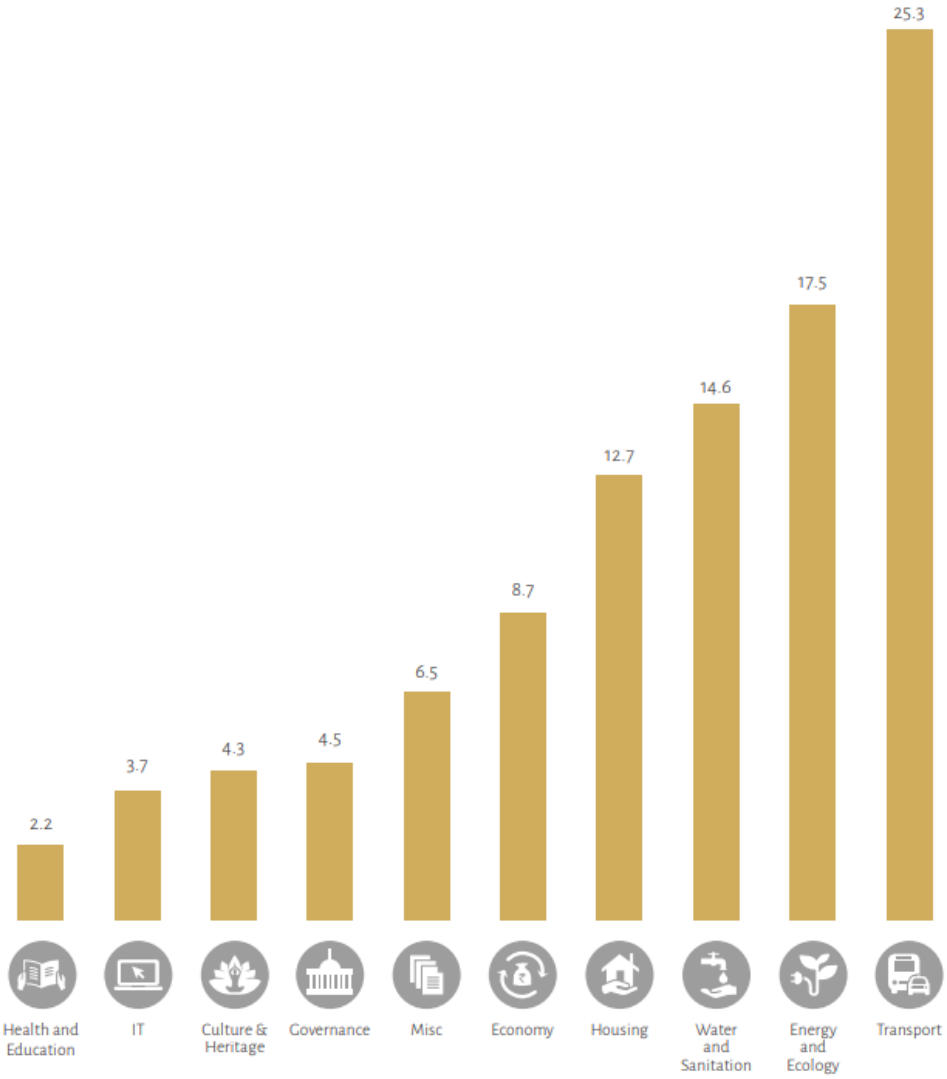
Financial Item	Amount (in INR billion)
Total fund requirement (project costs)	2,050.18
Financial support by central government	480.00
Matching contribution by state/local government	480.00
Total funds to be mobilised by central and state/local government	960.00 (47% of 2,050.18)
Funds to be mobilised by central and state/local government for each city per year (approx. INR 1,000 billion ÷ 100 cities ÷ 5 years)	2.00
Balance funds to be mobilised from other sources	1,090.18

Combined central and state government financial support amounted to slightly under half of the estimated total funding requirements for projects launched under the NSCM. As a result, participating cities were required to set up a Special Purpose Vehicle (SPV) for the purpose of mobilizing new private sources of funding for these projects through a PPP model. Source: Aijaz, Rumi.

Proposals for the SCM were largely developed by Urban and Local Bodies (ULBs) in partnership with consulting firms, with technical and financial advice from foreign governments and varying degrees of input from citizens and other stakeholders. These proposals were then approved by the SCM's National-level Apex Committee, which additionally monitored project activities, recommended mid-project adjustments, and was responsible for releasing public funds to SPVs under the direction of a national mission director. Furthermore, each state managed its branch of the SCM through a High-Powered Steering Committee (HPSC), which provided guidance and a forum for the exchange of ideas for all the cities and projects under its purview. A final level of cooperation existed at the SPV level, with the convening of Smart City Advisory Forums (SCAFs) by SPV CEOs to encourage stakeholders to collaborate with each other.

SCM projects were formally classified into two categories: area-based development and city-wide development. City-wide developments were intended for the benefit of the entire urban area, and often featured the most innovative applications of ICT in the SCM with the greatest potential for inclusive benefits to the population. On the other hand, area-based developments involved intensive investment in a relatively small geographical area, intended to serve as a proof of concepts of smart urban renewal to surrounding municipalities, and could further be divided into three separate models: retrofitting, redevelopment, and greenfield development. Retrofitting projects installed new infrastructure in existing built areas of at least 500 acres, with the intention of improving efficiency and livability. Redevelopment, or "brownfield" projects, replaced an existing built environment of roughly 50 acres with a new one designed around principles of mixed-use development, increased density, and technological integration. Greenfield developments took vacant rural land or farmland outside of existing urban areas in the ballpark of 250 acres and constructed an entirely new built environment which integrated smart infrastructure into its design. The GOI's initial vision for "100 new smart cities in India" hewed closely to the greenfield development model, but over time, cities have preferred implementing redevelopment and retrofitting schemes. This is not only because these models are less costly,

but also because the ULBs charged with designing and introducing projects naturally prefer investing in developments within the existing boundaries of their urban areas.



The transport sector received the highest percentage of the total amount budgeted through the SCM, followed by energy and ecology, water and sanitation, housing, and economy. These categories were similar to those pursued under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) between 2005 and 2012, while IT, governance, and culture and heritage were introduced as new categories. Source: Centre for Policy Research India.

Area-Based Development: Retrofitting

Retrofitting schemes have often involved casting a vast net and implementing a highly diverse and not necessarily complementary set of projects in a specific, favored geographical region. The range of SCM investments in New Delhi City Centre (NDCC) is exemplary of this model. In a city with governance institutions fragmented across geography and a high level of inequality, NDCC was chosen as the site for the implementation of a high proportion of the city's SCM projects because it had the highest level of existing IT infrastructure in the city, because it had

high levels of economic and cultural significance, and because the New Delhi Municipal Council had greater capacity than its neighbors, a track record of implementing prior smart projects, and a AA credit rating on the back of a track record of operating without debt, and even with a running surplus for several years. In theory, a project in this area would yield greater results because it would attract greater funding from private investment, would impact more people, and would be implemented more effectively. The outcomes of this success, highly visible to other municipal agencies such as the North, South, and East Municipal Corporations of Delhi, would then prompt these other actors to make their own investments in area-based development.

The majority of funds tendered to Delhi under retrofitting schemes fell under the category of energy, as part of a large-scale rooftop solar and smart grid installation. Mobility and Parking was the next most popular category, followed by smart water and wastewater management. Meanwhile, individual projects varied widely. To take several examples, Funding under the SCM went to the 2017 opening of the Charkha Museum and Training Centre, a site meant to promote the cultural identity of khadi weavers and connect them to the heritage of the city. Public Amenities Centres (PACs) transformed public toilets in NDCC into hubs featuring clean water dispensers, cash machines, and even digital clinics, fully under the management of private companies. NDMC also partnered with the German company NextBike to install GPS-equipped bikeshare docks across NDCC, and inked a separate partnership with Yulu to provide e-bikes. Digital information and service panels were also installed in locations across NDCC, providing free data, wifi, and mobile charging points to pedestrians in the district in a fashion similar to New York's LinkNYC kiosks. Finally, in an effort to alleviate traffic near Connaught Place, smart parking lots were introduced which featured displays showing current occupancy rates and were linked to a website and app which would allow drivers to remotely check availability in parking lots in the area. This is by no means exhaustive – Delhi has tendered a total of 1152 crore INR (154 million USD) for 100 projects under the SCM, completing 89 so far – but it constitutes a reasonably fair summary of projects within the NDCC.

Area-Based Development: Redevelopment

East Kidwai Nagar, in the heart of south-central Delhi, is likely the most notable example of a redevelopment scheme implemented under the SCM. The mixed-use development, built over 86 acres, includes 4700 apartments, 102,000 m^2 of office space, a commercial center, and a secondary school, powered by a rooftop solar network which allows the entire development to be almost entirely carbon-neutral. Residents enjoy a large central green space and close proximity to public transit, two factors which contributed to the development's receipt of the award for "Best Public Service Architecture in India" at the 2017-18 International Asia-Pacific Property Awards. However, the development has not been without its share of controversy, with concerns raised about water supply, design shortcomings, and the project's poor fit with the city's exist Transit-Oriented Development (TOD) policy due to excessive provision of parking space. At a more general level, the project was criticized for introducing another gated community into Delhi's urban fabric under the guise of sustainability.

Mumbai's Bhendi Bazaar project is another well-known foray into redevelopment funded by the SCM at a total cost of over 4000 crore INR. Under the direction of a local nonprofit, the

redevelopment will ultimately house 3200 families and 1250 shops by 2025, spread over a 16.5 acre area featuring towers reaching as high as 41 stories. The redevelopment has been a vehicle to deliver formal ownership rights to residents of the district, many of whom had lived in dilapidated buildings vulnerable to natural disasters without formal title. The project, however, has on occasion been stalled due to complexities in negotiating land transfer from residents unwilling to vacate their homes, due in part to lack of trust that they will receive a guarantee of land title in return.

Area-Based Development: Greenfield Development

Greenfield developments show the SCM's vision at its most ambitious, and paradoxically, at its most tenuous relationship to certain recognized practices in sustainable urban development. By building on large, untouched, and unbroken parcels of land, greenfield developments offer the opportunity to imagine and realize a technological, sustainable city from the ground up. Gujarat International Financial Tec-City (GIFT City), between Ahmedabad and Gandhinagar, shows Indian smart city greenfield development at its most ambitious. A project conceived in 2007, GIFT City was designed as an 886-acre international business hub specializing in fintech which will provide residential and office space comparable with other international business districts such as La Défense in Paris or Pudong in Shanghai. Upon completion, the development will be home to India's tallest building, the 410-meter Diamond Tower. As India's first greenfield smart city, GIFT City features a number of groundbreaking innovations in design and infrastructure. Designed to be entirely walkable, the district boasts an automated garbage disposal system and a centralized cooling system for the entire development which reduces energy requirements for air conditioning by an estimated 30-40%. The area will additionally be connected to the Ahmedabad metro system by 2024. Yet despite its ambition, GIFT City has encountered its share of problems, particularly since the onset of the COVID-19 pandemic, struggling to attract business tenants in an era of social distancing and remote work.

Maharashtra's Palava City is another highly-regarded greenfield development. A new development by the Lodha Group, Palava was named India's no. 1 smart city by a 2017 research report. As of May 2020, the mixed-use development housed 200,000 residents, integrated transportation, waste, and utility management, a high ratio of green space, and a dedicated solar power supply. Palava II, due for completion in 2030, will host 7 million square feet of retail and commercial space and half a million residents, while Palava III, tentatively scheduled for completion in 2050, will up this to 40 million square feet of commercial space. Palava has been described, by some, as the ideal city, but it has been criticized by others as a segregated vision of the smart cities of the future, in opposition to the inclusion requirements of sustainability. For instance, the city's squarely upper-middle-class residents are issued a community-specific ID care which controls access to the city's services and facilities, and are promised a "smart surveillance" system to keep them safe from outsiders. The development, somewhat revealingly, describes itself as "Mumbai's first and only golf-course-equipped residential township;" an activity that has nothing to do with either smartness or sustainability, let alone when taking place on a course built on expropriated farmland. At 40 kilometers from Mumbai, the new city is more of a retreat from urban life than an elevation of it, raising the question of who exactly India's smart city model as currently formulated is intended to serve.

City-wide Developments

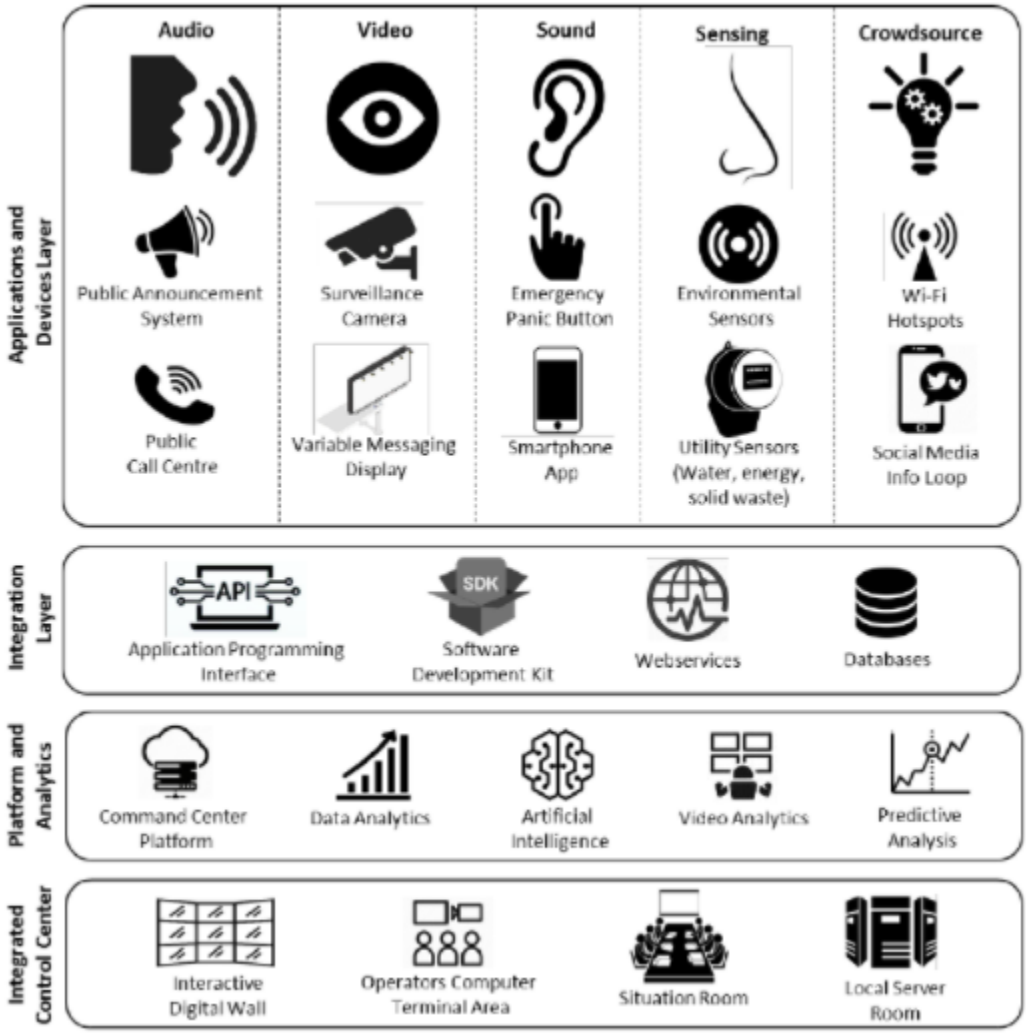
The final development model included under the umbrella of the SCM, city-wide developments are intended to benefit the population of the entire geographical area of the city, instead of limiting themselves to specific focal neighborhoods. City-wide developments within the SCM range from the miniscule to the transformative. Cities often used these proposals to attempt to introduce innovations such as smart water and power usage meters, develop Bus Rapid-Transit (BRT) networks, improve the network connectivity of transit infrastructure, or commission new technology in schools and clinics across the city. At the other end of the spectrum, city-wide projects could be as small as one case in Trivandrum which bought a total of 30 e-autos and e-rickshaws equipped with GPS systems and gave them away to female drivers below the poverty line. The only standard for these projects is that their impact not be limited to a geographical subset within the city.

Over the course of the SCM, nearly all cities have come to make meaningful investments in developing centralized big data command and control centers, referred to as "Integrated Command and Control Centers" (ICCCs), as part of their city-wide development strategy. Originally intended as a means to use real-time monitoring of big data to generate insights into urban trends and respond to events more quickly, ICCCs have also proven to be useful from an urban planning standpoint by generating dynamic data on the state of cities. Previously, cities were relying on data that was often several years out of date for their planning processes, such as Census data, which is updated only once every ten years. The first ICCC was established in Ahmedabad in February 2018, drawing on the successful implementation of a similar command and control center in Rio de Janeiro in 2016. The Ahmedabad ICCC received the SCM's award for the most innovative smart city project following its introduction, and other cities quickly followed suit. The investment in ICCCs under the SCM is expected to reach 20,000 crore (2.76 billion USD) by 2022.

ICCCs may have become a universal feature of Indian smart city projects, but that does not mean they are all created equal. The most committed cities have dedicated upwards of 10% of their total smart city budgets to these centers, topping out at 16% of the total budget for Prayagraj. These cities can use their new data centers as hubs for collection of big data from audio, video, sound, sensor, and crowdsourcing devices, enabling a comprehensive integration, analysis, and response to this data which links services citywide, creates synergies across sectors, and improves coordination between levels of government. On the other hand, investment in ICCCs was under .5% of the total budget in cities such as Varanasi, Shillong, and Solapur. These cities cannot expect their ICCCs to do anything more than facilitate a handful of piecemeal technological services.

Regardless of their size, Indian ICCCs operate according to a fairly standard, four-tier hierarchy which offers the potential both for high levels of data analysis internally and entrepreneurial involvement externally. At the foundation, big data is collected through an application and device layer and fed into the system. At certain levels, basic analysis of this raw data can be sent back to immediately influence user behavior, through tools such as electronic displays, public

announcements, or smartphone notifications. At the integration layer, this data is stored in organized relational databases, and made accessible for internal and external analysis and development via platforms such as web applications or open-source Application Programming Interfaces (APIs). Data is analyzed and acted upon in the Platform and Analytics layer, which incorporates human data analysis as well as more advanced tools such as AI-powered predictive analytics to actually use incoming data to streamline the efficiencies of a city. Finally, the integrated data environment for the entire city is managed in a physical control center, whose interactive digital displays have in many ways become the face of the entire Smart Cities Mission.



83 of the 100 cities involved in the NSCM have implemented an Integrated Command and Control Center (ICCC) to gather, analyze, evaluate, and respond to big data inputs from across the urban area. ICCCs typically operate according to a schematic outlined in the above diagram. Source: Praharaj, Sarbeswar.

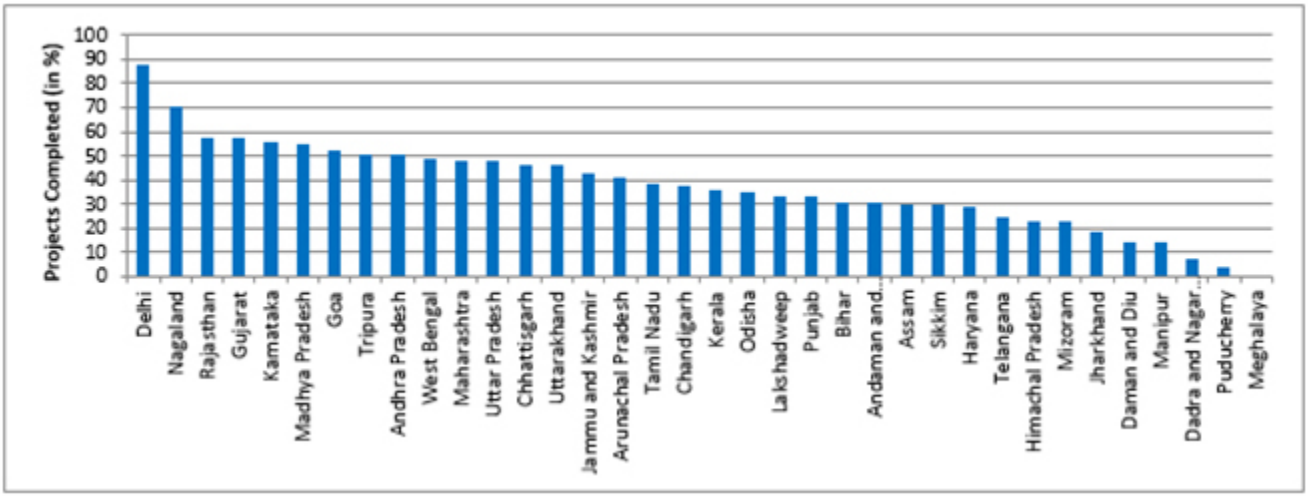
ICCCs were largely founded to improve urban transport and surveillance, with better-equipped ones taking on responsibilities in other domains such as solid waste management, water sensors,

and smart street lights. However, activities such as flood monitoring or disaster management have rarely been assigned to them, despite the high climate risk faced by many Indian cities and the importance of fast, efficient, and coordinated responses in such situations. One exception to this role has been the COVID-19 pandemic, in which ICCCs were drafted into helping to coordinate an emergency nationwide response. ICCCs were charged with coordinating hospital bed requests, monitoring infection hotspots, managing oxygen capacity, directing ambulance services, developing web apps for contact tracing, and managing telemedicine lines, among other activities. Their record was mixed, but such an outcome was not unexpected for an untested, fledgling system that, in many places, has struggled to find staff adequately trained to use the massive amounts of information they are privy to.

Challenges within the SCP

Project Funding and Implementation

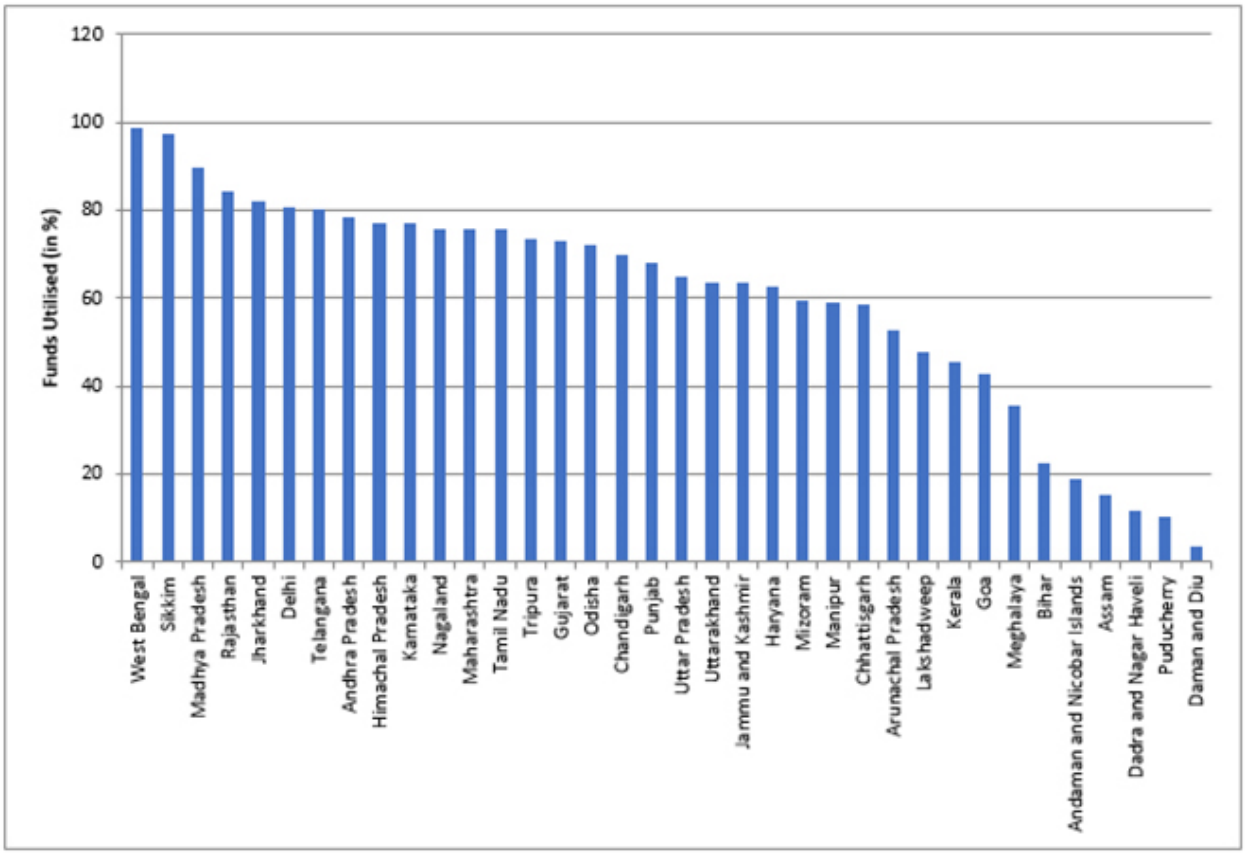
Each member city within the SCM was expected to finish its projects under the program within a span of four years, yielding a series of completion deadlines for the project between 2019 and 2023. However, many cities have lagged well behind this goal. Out of the 6387 projects tendered under the SCM so far, only 49% were complete as of September 2021. While the completion rate stands at over 80% in cities such as New Delhi, and Bangalore, 15 of the SCM's 100 cities had completed under 20% of their projects, with a further 46 under 40%. In general, more developed, populous states saw higher project completion rates in contrast with lower rates in smaller and less developed states. This potentially points to a scarcity of local talent for SPVs in smaller states to draw on, and in particular, an inadequate degree of interstate support, communication, and collaboration within the framework of the SCM.



Smaller and particularly northeastern states and UTs have issued fewer tenders and experienced a lower project completion rate than large states. This is indicative of limited capacity at the state and local level in these areas and inadequate technical support coordinated for their benefit at the national level. Source: Aijaz, Rumi.

One of the primary causes of these delays has been the SPV PPP model on which the entire implementation strategy of the mission was based. SPVs encountered frequent managerial, technical, and financial difficulties, which were complicated by delayed disbursement of funds and inadequate training in data handling and analysis. As of August 2021, only 23% of tendered funds had been released, mainly due to slowdowns on the public side; the central government and state/local governments had only released 13% and 10% of tendered funds respectively, with no city receiving more than 45% of tendered funds due from state governments. In the most extreme example, the state of Telangana has not yet released any funds connected to the SCM.

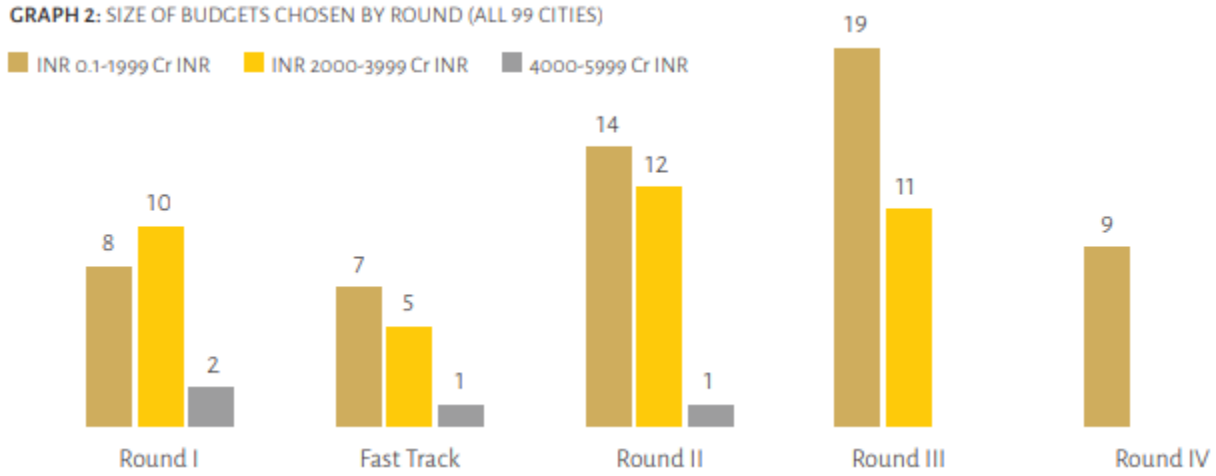
What has been the driver behind this unacceptably slow disbursement of funds to SPVs? On one level, release of funding has been delayed by the failure of states and UTs to mobilize the counterpart funding required under the guidelines of the SCM. ULBs have in some cases resorted to selling their own assets in order to meet the level of fundraising required of them to receive matching funds through the scheme. Municipal corporations have also experienced operational dysfunction which has hindered distribution of funds, and local fiscal weaknesses have incentivized local officials to postpone payments until their finances reached a more stable and consolidated position.



Project delays have largely been caused by the requirement that SPVs mobilize counterpart funding before public funding is released. As a result, utilization of funds released for the project have ranged from near 100% in West Bengal to under 30% for Bihar and small UTs such as Andaman and Nicobar Islands, Dadra and Nagar Haveli, and Daman and Diu. Source: Aijaz, Rumi.

SPVs are also partially responsible for failing to meet a high enough standard for municipal governments to feel enough confidence in their ability to perform the work demanded to distribute funding to them. In Panaji, for instance, the SPV went without a governing board for over a year, with four positions remaining vacant while the company has been faced with numerous auditing violations. ULBs have also been left in the dark about whether SPVs are intended to continue managing SCM projects after the conclusion of the mission or whether responsibility will pass to local governments. This deficit of planning for continuity and programmatic sustainability has reduced the commitment of local governments to projects undertaken through the mission. Perhaps most fatally for the prospects of the cooperation between SPVs and ULBs necessary for the success of the SCM, the very use of SPVs as primary implementors was heavily criticized as no more than a means of bypassing municipal governments and the democratic process. With SCM governance boards required to provide central and state governments with a majority of the seats, this design stood in stark contrast to the SCM's marketing as an investment in empowering local governments. The separation of SPVs from the democratic process was made even clearer by the fact that the SCM included no grievance redress mechanism and no right to remedy for impacted city residents. These concerns around diluting the power of the municipal corporation were so serious that the ULBs of Mumbai and Navi Mumbai refused to participate despite the SCM's potential development benefits.

Over time, a deep conflict was revealed between the SCM's strategic vision and its funding and operational structure. SPVs were required to develop a dedicated revenue stream and their own credit worthiness to gain additional funding. This led them to favor PPP projects with immediate market feasibility, not projects with the greatest potential benefit for sustainability or for poor and excluded populations. This led the SCM to drift towards funding the same kinds of physical revenue-generating infrastructure as prior urban renewal schemes, targeted towards areas with an ability to pay. This was made more prevalent by the fact that the SCM gave cities the latitude to define any project they wanted to as "smart," further reducing differentiation between the SCM and earlier projects. Meanwhile, cities in later rounds of the program witnessed the instability of reliance on private funding and downsized the ambition of their projects to rely more on government grants. This may have helped these projects gain approval, but it did not help resolve the funding disbursement issue, making these projects even more prone to delays. At the same time, certain cities such as Bhubaneshwar and Thane made some of the most ambitious proposals in the entire SCM without providing any detailed information about their proposed sources of funding, even though a financial plan with itemized costs, resource plans, revenue and payback mechanisms, plans for cost recovery, and a financial risk mitigation framework were ostensibly required to successfully take part in the application process. It remains an open question why enforcement of compliance was so lax for these particular cities.



Cities shifted toward proposing less ambitious projects with smaller budgets with less reliance on market-based funding over the course of the SCM, partially due to uncertainty over the reliability of funding sources. This limited the impact of the SCM for more excluded populations and contributed to the SCM becoming a source of urban inequality, rather than equality. Source: Centre for Policy Research India.

Project Selection

The SCM's competitive application used a number of metrics to ensure that the individual projects selected for inclusion under the mission were the best performers on a strict and detailed rubric in alignment with the Mission's vision and goals. This was intended to make certain that the projects funded under the mission were thoroughly conceived, detailed and thought out. What this process did not do was incorporate any metric for whether a project met the specific needs of a city, as it was assumed that cities would submit projects meeting their greatest development needs. Nor did it include a weight for the overall need of a city for development investment, as high-performing cities were anticipated to become "lighthouses" which would spark independent investment by municipalities not party to the program. Neither of these assumptions have so far been born out. The competition incentivized ULBs to design their projects to maximize the possibility of funding, maximizing their point totals under the rubric even when this pushed them towards low-priority projects which didn't meet local needs. City residents had little meaningful input into the projects put forward, with Facebook likes and even Twitter impressions recorded as positive feedback to SCM proposals with no further inquiry. Nor did this model align submitted projects with a cohesive national strategy. While the projects funded may have all met the definition of smart development outlined in the SCM guidelines, actual smart development is a cumulative process requiring foundational infrastructure, investment in skill development and, last but not least, smart applications built upon these two pillars. The emphasis on individual projects through the SCM did not follow the required order of operations for building a smart city.

Nor did the projects funded under the SCM necessarily fit international definitions of what should be considered as "smart." For instance, Agra used its funds to found handicraft training centers for traditional embroidery and stone inlay. Coimbatore restored a number of lakes and invested in developing food kiosks, open plazas, fountains, and an ampitheater. Kavaratti

installed a rainwater harvesting system and a combi8nation compost-recycling-incineration center for solid waste. Prayagraj installed a plastic-to-diesel conversion plant, while Surat installed parking on highway medians. Solapur is simply redeveloping a sports stadium. These projects may have been considered high development priorities by the ULBs in charge, but they shouldn't have been considered smart without the inclusion of a technological layer with the capacity to interface with residents or other city services.

Nor were SCM projects examples of sustainable development, in many cases. The greatest red flags for sustainability have come in the transportation sector. Nearly 40% of the transportation budget under the SCM has gone to roads and parking lots, with only 2% dedicated to buses and 13% dedicated to non-motorized transportation. Bhopal's plans included a road-widening project, widely seem by modern urban designers as an engine for increasing traffic, sprawl, air pollution, and GHG emissions. These projects ultimately amount to an investment in an anti-urban form of private transportation at the expense of sustainability in exchange for guaranteed economic returns, perfectly opposite to what the goals of a national smart, sustainable city mission should be. Projects such as Bhopal's also resulted in high rates of eviction and displacement for residents of informal, vulnerable communities. In fact, projects in the Energy and Ecology space were permitted to pursue "beautification" projects, which some cities interpreted as *carte blanche* for funding slum demolitions. A total of 20% of the budget for housing-related projects was dedicated to slum redevelopment. Disruption is unavoidable in urban development, especially if existing living patterns do not meet standards of sustainability. But when no provision is made to provide existing residents rights and title over their land, displacement and homelessness are the likely result. With no measures taken to formally count the number of people displaced or made homeless by SCM redevelopment projects, it's even possible that these investments caused a net decrease in the number of homes in some cities – in the middle of a national housing crisis.

Ultimately, the intentionally vague language of the SCM was used to obfuscate the program's outcomes in two separate ways. Describing projects with no technological involvement as "smart" allowed stakeholders to sell the SCM as a substantially more radical modernization program than it has become, regardless of whether any individual project met the principles of sustainable development or not. For projects which had nothing to do with sustainable development, casting the project as "smart" instead of "sustainable" to some degree dispelled scrutiny over whether these investments actually met the development needs of India's urban areas. Yet India's cities are in desperate need of investment in improving their sustainable development outcomes, as evidenced by the continued shortfalls in basic service delivery, infrastructure, and governance in the country's urban areas. Many commentators have argued, not incorrectly, that India's cities need to invest in becoming sustainable before they even think about becoming "smart." Since smart technology only enhances the efficiency of existing systems, the underlying sustainability of them matters, especially in a high population growth environment where high demands will be placed on urban infrastructure in the coming decades.

It's not necessarily that insufficient funds were dedicated under the SCM to help meet the demands of sustainability. Rather, the competitive grant structure of the SCM has incentivized a fundamental misallocation of these funds. A full 80% of SCM funds have been dedicated to area-

based development, covering incrementalist retrofitting as well as redevelopment and greenfield development schemes which only impact the tiny proportion of the population of participating cities – 10% of the total city area under the SCM, and as low as .8% in cities such as Pune. Only a small minority of the total budget was allotted to city-wide development schemes, which have a much greater potential for transformative, inclusive, and even "smart" impact. Funding shortfalls across the program clearly indicate that more was awarded to these area-based developments than was actually readily available, and that more could have been made available for "smarter," more cost-effective city-wide plans by deemphasizing area-based development, provided similar levels of funding would have been available for scaling these up.

In Pursuit of Smarter, More Sustainable Urban Development

The SCM had the potential to be a transformative program when the idea for it first gained traction, but unfortunately, it was undermined from the start by a number of harmful design flaws which rendered it less capable of meeting the most urgent needs of India's cities. The Mission's PPP-reliant funding and implementation mechanism undermined trust among civic partners, while failing to deliver the timely funding necessary for projects to be completed according to the program calendar. Inadequate provisions were made to build the capacity of stakeholders to engage with the data flows generated by project infrastructure, diminishing their impact, and increased collaboration and cooperation should have taken place between states to narrow the geographic skills gap. The siloed, competitive grant process prevented projects from having synergies with each other within or between cities, and ULBs were incentivized to propose projects that maximized the probability of funding, rather than those which met their core development challenges. The program also pursued development in small areas with high existing levels of development under the theory that other areas would follow suit, without doing enough to elevate the capacity of municipalities not selected under the SCM. Finally, at a semantic level, the definition of "smartness" was blurred to the point that it had little to do either with technology or with sustainability, leaving cities to propose whatever projects might maximize the possibility of new revenue streams, especially from private sources. Some have even argued that the purpose of the SCM was not to develop Indian cities, but to rather develop their credit ratings to push them to draw more on private-sector financing in the future. At the SCM's outset, some criticized the program for allegedly promoting inequitable development despite its stated mission, such as the State Government of West Bengal, which even briefly withdrew from the SCM before returning in a limited capacity. The flaws in the program mean that to some degree, these criticisms have been borne out in the end.

The SCM has, nonetheless, produced some highly valuable takeaways. The most important of these has been the rise of ICCCs within India's major urban centers. At their best, ICCCs can improve coordination in the messy, federalist relationship between state and municipality, while driving the integrative management of big data towards the goal of a smart, sustainable city. Boston's 'CityScore' system is an excellent example of how data can be used to influence decision-making and policymaking in the short and long term, with real-time indicators on transport, safety, health and human services, and utilities applied by city government both to take immediate actions and plan future investments in a cycle of constant self-improvement.

At this point, the majority of ICCCs in India have not yet reached this level of ambition. Their applications so far have largely been limited to managing the surveillance and security of an urban area, and have mostly fallen under private management as an artifact of ULBs' efforts to attract private funding under the constraints of the SPV model. This is concerning because in effect, the SCM has forced cities to sell one of their most valuable assets – their citizens' data – for pennies on the dollar. The value of this big data will grow exponentially in the future, and public ownership of these datasets will pay back immense dividends in the form of new entrepreneurship and civic innovation.

One potential reason that the SCM leaned so much on private-sector partnerships to implement its projects, rather than public agencies, is that designers were concerned that municipal governments would lack the capacity of the private sector to carry out the program. This is a reasonable short-term viewpoint, but for long-term smart city development, municipal authorities need to build the governance capacity and technological competence to manage such projects. If they do not yet have it, then investment should first go into making sure that they do before introducing innovations that they, let alone neighboring cities not selected under the SCM, will not be capable of maintaining or replicating. As the Smart City Guidelines succinctly put it, "the Smart Cities Mission requires smart people," and the current structure needs to do more to cultivate and mobilize these people. Given India's high levels of digital talent, promoting higher levels of civic entrepreneurship and technological volunteerism may be a good pathway to developing this capacity.

As things currently stand, smart cities are not recognized as the independent political and economic entities they need to be to realize a cohesive vision of smart, inclusive, technological growth. ULBs are often only responsible for the most basic public services, with state governments using the excuse of a lack of municipal capacity to take responsibility over the rest. This further weakens municipal capacity, to the point that when ULBs are asked to execute projects requiring this capacity, they rely on external consultants who lack a personal or democratic connection to the city's needs. To some degree, the SCM bought into a myth of permanently diminished municipal capacity by pushing SPVs to assume control over projects, but little evidence so far has suggested that SPVs have been an improvement on direct municipal control. Regardless of how flawed local political institutions are, attempting to streamline and reform them instead of bypassing them is worth it because a functioning, empowered, and unitary city government does not suffer from the misalignments of incentives that stunted the SCM and have hobbled solutions for so many of India's other urban challenges.
Municipal empowerment is important to building smart, sustainable cities, but so is confronting the anti-urban legacies which have helped make some of India's cities so unsustainable. For instance, obsolete urban planning laws, such as Mumbai's unreasonably low Floor Space Index (FSI) requirement of 1.33, are incompatible with dense, mixed-use, transit-friendly development. Urban economist Edward Glaeser noted that "cities grow upward or outward," and Indian cities have been growing outward without meeting the resulting demand for basic services or infrastructure resulting from such growth. The outcome is sprawl, traffic, and poor public services. Such city-level challenges are a collective action problem, and India's urbanization poses a collective action problem at the national level, but measures such as the 74th amendment enshrining decentralization and devolution in national governance make such macro-level

problems challenging to address at adequate scale. Gandhi may have viewed India as a country of 700,000 villages, but governance has to reflect the reality of the changing urban landscape. While local government needs greater capacity to execute a collective vision, empowering local governments and neighborhood committees with the formal power to guide national governance may be a structurally ineffective means of confronting national challenges.

After the SCM

If the SCM is intended to make an impact beyond the duration of the program itself, it needs to be converted to a long-term program. Low levels of development in Indian cities and limited governance capacity require a sustained commitment to social and economic transformation and avoidance of unrealistic promises. Such capacity takes time to develop, but governance capacity is the limiting factor to the success of the big data urbanism envisioned by the SCM. Capacity can be developed by expanding training programs for both SPV and ULB program officers, as well as funding them adequately and providing them with sufficient personnel and equipment. If the SPV model is maintained, the Mission should start by clarifying the disbursement chain from the central government to the state and local levels and from these lower levels of government to the SPVs to avoid future delays. The Mission should also investigate SPVs in laggard cities in depth to determine exactly what went wrong and what not to replicate. ICCCs should expand their responsibilities as capacity increases to manage a wider variety of urban services, and a focus should be placed on maintaining new smart infrastructure rather than issuing proposals to build more. Finally, cities should work with the SCM to align projects with city development priorities, to apply new financing tools such as new modes of taxation and municipal bonds, and to enhance data security and encryption standards across the project.

New initiatives have already emerged on the horizon which address many of the SCM's shortcomings. On February 23, 2021, MoHUA launched the National Urban Digital Mission (NUDM), an undertaking with the goal of building shared digital infrastructure in all of India's urban centers through 2024. NUDM would apply open APIs to encourage interoperability and greater stakeholder involvement, and has already gained partnerships with urban governments, industry assocations, academia, civil society, and entrepreneurs. This new digital infrastructure platform would be integrated with current open government platforms such as Aadhaar, UPI, and GSTN as part of the consolidation of a new national digital ecosystem. Another new digital infrastructure platform is the India Urban Data Exchange (IUDX), developed jointly by MoHUA and IISc Bengaluru. IUDX will produce an open-source dashboard of data on all available urban indicators, gathering data from sources such as air quality monitors, flood sensors, bike docks, buses and bus stops, waste management vehicles, and crowdsourced reports from citizens themselves. A third data platform, SmartCode, will serve as an open repository for smart governance tools, sharing source code for successful applications. SmartCode will accelerate the civic technology development process by letting users manipulate solutions which have already been developed, helping cities avoid reinventing the wheel.

Indian cities have struggled with ICT-driven service delivery models for some time now, as evidenced by the fact that 38 out of the 67 cities included under the Jawaharlal Nehru National Urban Renewal Mission, launched 2005 and relaunched in 2015 under the name of the Atal

Mission for Rejuvenation and Urban Transformation (AMRUT), failed to develop the eGovernance portfolio expected of them. If limited technical capacity is the reason behind this, then initiatives such as the National Urban Learning Platform (NULP) can help improve local technical governance capacity by offering open training in areas such as wastewater management, data governance, climate best practices, and e-mobility. Under a different program, TULIP (Tata Urban Learning and Internship Program), MoHUA is working with Tata Trusts to train city officials to understand, analyze, and implement recommendations from big data. To this point, TULIP has sponsored 13,000 internships in 284 ULBs focused on data-driven governance. To help cities plan out their new ecosystems for data-driven governance, the GOI also introduced the DataSmart Cities and Data Maturity Assessment Framework, a set of guidelines tracking the steps cities need to take to gather, understand, and act upon big data.

Finally, an array of initiatives continue to press forward to improve the delivery of basic services in urban India. Jal Jeevan Mission, announced in the 2021 budget, allocates 2.9 lakh crore INR (39.4 billion USD) to delivering an uninterrupted water supply to all 4378 ULBs in India, covering tap connections to 2.86 crore households and liquid waste management for the 500 cities in the AMRUT program. AMRUT, which leans far less heavily on PPPs and private investment than the SCM, will also invest in developing urban green spaces and reducing pollution by incentivizing a switch to public transit and non-motorized transport. Phase II of Swachh Bharat was announced in February 2020, with a focus on entrenching the gains made in Phase I and managing wastewater in all cities, towns, and villages with populations under 100,000. And Housing for All 2022, announced in 2015 otherwise known as Pradhan Mantri Awas Yojana (PMAY), aims to construct a total of 20 million affordable homes with full utility and sanitation connections in rural and urban areas by the program’s completion in March of next year.

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