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Challenges in development and implementation of Indian smart city mission

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ABSTRACT

The rapid rise in India's urban population is mainly in search of employment and education. Due to this rapid urbanization, the government is suppressed to concentrate on solutions for certain problems like overcrowding, pollution, resource constraints, needs for the development of infrastructure and restoration of ageing Infrastructure. As to meet these demand and problems, India has stepped into developing and constructing major cities as Smart cities in 2015 as 'National Smart Cities Mission' under Union Ministry of Urban Development. It is an initiative to make these cities friendly and sustainable to citizens as well as to nature. Some major barriers in developing a smart city in India are financing or allocation of budget, availability of resources, planning with most advanced techniques and making people used to it, rehabilitation and resettlement of huge population. Indian cities are already well-developed cities when compared to others, but through proper planning and implementation, it can also be made into Best smart cities in the world. This paper focuses on the Idea of Smart City, concept of smart city mission of India, its challenges and implementation. And also about the Smart city solutions and initiatives in some of the major smart cities of the world.

Keywords: Smart Cities, Strategy, Barriers, Indian Smart City Mission, Learning, Urbanization

1. INTRODUCTION

The smart city concept has become discussions in academic and policy in recent times. There is a wide range of approaches to defining a smart city it generally refers to an instrumented, interconnected and intelligent city that uses information and communication technology (ICT) to sense, analyze and integrate critical information on core systems in running cities. There is a large number of studies on smart cities focusing on the developing countries. Smart city policies in Asia are rapid urban development through "Fast Policy" (Peck and Theodore, 2015) – a process through which Private corporations are hired to import and execute smart solutions and initiatives that are successfully implemented. The policy-making in India, have a sharp focus on the Smart Cities Mission (SCM) aiming to make 100 selected cities into smart ones. The cities were identified by the Indian government by the nation-wide smart city challenge, where each one to make an individual Smart city proposal with ideas of their interest how their smart city wants to be. And also those cities are involved in collaborating with private corporations to develop their proposals. After selection as a centrally sponsored scheme, Union government give financial support to achieve their smart city goals.

2. SMART CITY

2.1 Define 'Smart City'?

The word smart city has no universal definition. Its meaning varies from one to another according to the viewer. In the view of India Citizen, the word smart City means an introduction of new technology. To get the aspirations and needs of the citizens, the smart city planner aims at developing and updating the technology of the city, which is surrounded by the four pillars of collective development social, physical, economical and institutional infrastructure. The goal or target is in the hands of the aspirant itself, it can be long term goal leads to adding suitable various layers of smartness.

2.2 Core infrastructure elements

Public Transport, Water and Electricity supply, Sanitation, Sustainable environment, Communication and Information technology, Housing for poor, Governance, Safety especially for women and children.

2.3 Smart city features

Green housing, Creating pedestrians friendly environment, Developing recreational parks and playgrounds, Eco-friendly transportation facilities, Mixed land use, e-governance making easy and citizen-friendly, Making an Identity to the city using its speciality, Disaster management and predictions.

3. INDIAN SMART CITY MISSION

In 2015, the Indian Ministry of Urban Development introduced the Smart City Mission (SCM) statement and guidelines. They put forth the four strategy to develop the cities - retrofitting, redevelopment, greenfield development and pan-city initiatives. The Smart Cities Mission has a unique feature that it has a strategy of greenfield development also not only on retrofitting model. First challenge of the mission is solution for urbanization. According to the 2011 Census 31% of the population of India settles in urban areas approximately and 400 cities population greater than 1 lakh. A forecast of the United Nations indicates an additional 30 crore urban population by 2050. Secondly, this urbanization leads to the shift of the economy from the urban areas including public transport and public utilities.

The objective of this mission is to provide a decent quality of life to the citizens in those urban cities by application of the latest technologies. Its focus mainly on inclusive growth with sustainable growth. This mission is a bold attempt to create role model cities that will be an example for other cities inside and outside the country. The purpose of the Smart mission is to make economic development and improve the standard of life of people by involving the technologies in their daily life. It includes the development of outdated infrastructure and transform existing slum areas into a better one in the whole city and also a new development around the city to accommodate the increasing urban population. The inclusive development tends to increase the standard of life, health and hygiene, employment and enhance income for poor. Indian smart city mission will cover 100 cities initially and thereby increase after five years by incorporating the learnings of the mission.

3.1 Strategy and Approach

The strategic development components of this mission are retrofitting (improvement), redevelopment (renewal), greenfield development (Creation), pan-city development (city-wide smart solution implementation).

3.1.1 Retrofitting: In an existing built-up area of more than 500 acres will be identified in the city to achieve smart city goals. Examining the levels of the existing area, the city will create a strategy to make it smart. As existing structures largely remain as it is in this model, only the smart applications will be inserted in the city of the retrofitted model. It can be completed in a shorter period.

Table 1: Retrofitting

Where	What	How
Existing built-up area Minimum 500 acres	Smart metering of Piped gas and water supply, High speed connectivity, Safety - CCTV, alarms, sensors, Smart lighting - LED lights with sensors.	Special purpose vehicles (SPV) - Union, State, Urban local bodies (ULB).

3.1.2 Redevelopment: It is an effect of replacement of existing built-up area and creating a new layout of more than 50 acres. It is prepared with mixed land-use, higher ground coverage.

Table 2: Redevelopment

Where	What	How
Existing urban area Minimum 50 acres	Mixed land-use, Higher floor area ratio, Green energy efficient buildings, Wide roads, Modern recreational areas	Special purpose vehicles (SPV) - Union, State, Urban local bodies (ULB).

3.1.3 Greenfield Townships: In a vacant area more than 250 acres with complete smart solutions, innovative planning to make affordable housing, especially for poor. Mostly this strategy is a creation of new city outside the urban area to divert and to solve the increasing population of that urban area.

Table 3: Greenfield Township

Where	What	How
Vacant Land Minimum 250 acres	Full Fledged smart city with maximum smart city components and smart construction.	Special purpose Vehicles - Public and Private developer

3.2 Smart City Proposal preparation

The Government has not prescribed any model to be adopted because it is not an approach that fits all in one. Each city can create its model, concept, vision, mission, steps for their smart city to satisfy their ambition. The city itself prepare their Smart City Proposal (SCP) with smart solutions, innovation, applications they prefer with some essential features. The SCP preparation will be a collaborating one as the funds and development involve all government departments, private corporations and also the citizens.

3.2.1 Essential features of SCP: The SCP will include a wide range of smart initiatives. Essentially the elements that should be included in the SCP are at least 10% of assured electricity supply from solar, wastewater recycling, flood water reuse, rainwater harvesting, solid waste management, pedestrian's friendly pathways, intelligent traffic control system, underground wiring, ensuring the safety of the citizens, smart lights and smart metering systems. In the case of greenfield or redevelopment strategy, 80% should be green buildings. The proposals should be created more efficiently that should be smart enough as they are competing with each other cities for selection.

3.3 Number of Smart cities

The mission aims to develop 100 smart cities across the country and also these cities distributed all over the country. The government created a nationwide smart city challenge system, a completion model to select these cities. It provides an equal proposition to the population in urban and no. of statutory towns in the state/UT. By this, each has at least one smart city.

3.4 Process of selection of smart cities

There are two stages in the selection process.

3.4.1 Stage 1- Shortlisting of cities by states: It begins with shortlisting the cities by allocated number to the state. The first stage is an intra-state competition in which they are graded with some conditions and scoring criteria. These conditions should be met in the first stage and the highest-scoring cities will be shortlisted. The selected 100 smart cities are announced by the Ministry of Urban Development (MoUD) with an evaluation done by State mission Director and approved by the High Powered Steering Committee (HPSC). The first stage selected cities are recommended to participate in the second stage.

3.4.2 Stage 2- The challenge round for selection: In this second stage, each of the 100 cities prepares the proposals for city challenge. This proposal should include which type of model is chosen (retrofitting or redevelopment or greenfield development or pan-city development). It should also include the financing type, idea to attract private participation. These cities may get assistance in developing the smart city proposal in the second stage. This proposal is evaluated by a committee of field experts (National and International) from various organizations. The cities which got a high score to start making their smart city, while those who not get selected should work on improving their proposal to consider in the second round.

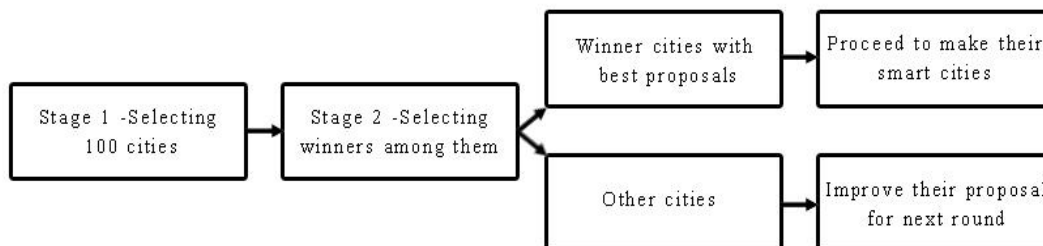


Fig. 1: Flow chart for selection process

3.4.3 Shortlisted cities

First round- 20 smart cities

Bhubaneswar, Pune, Jaipur, Surat, Kochi, Ahmedabad, Jabalpur, Vishakhapatnam, Solapur, Indore, New Delhi, Coimbatore, Chennai, Ludhiana, Bhopal, Davangere, Kakinada, Belagaavi, Udaipur, Guwahati.

Second round- 13 smart cities

Lucknow, Bhagalpur, Chandigarh, Faridabad, Raipur, Ranchi, Dharamasala, Warangal, Panaji, Agartala, Imphal, Port Blair, New Town Kolkata (Withdrawn).

Third round- 27 smart cities

Amritsar, Kalyan, Ujjain, Tirupati, Nagpur, Mangalore, Vellore, Thane, Gwalior, Agra, Nasik, Rourkela, Kanpur, Madurai, Tumakuru, Kota, Thanjavur, Namchi, Jalandhar, Shimoga, Salem, Ajmer, Varanasi, Kohima, Hubli-Dharwar, Aurangabad, Vadodara.

Fourth round- 30 smart cities

Thiruvananthapuram, Naya Raipur, Rajkot, Amravati, Patna, Karimnagar, Muzaffarpur, Puducherry, Gandhinagar, Srinagar, Sagar, Karnal, Satna, Bengaluru, Shimla, Dehradun, Jhansi, Pimpri Chinchwad, Bilaspur, Pasighat, Jammu, Dahod, Thoothukudi, Tiruchirappalli, Tirunelveli, Tiruppur, Aizwal, Prayagraj, Aligarh, Gangtok.

Fifth round- 10 smart cities

Erode, Saharanpur, Moradabad, Bareilly, Itanagar, Silvassa, Diu, Kavaratii, Bihar sharif, Shillong.

3.5 Special Purpose vehicle (SPV)

SPV is created at the city level to implement the Smart city mission. It will propose, funds, implement, operate, manage and monitor these projects. Each city has an SPV headed by CEO and members of Union, State and ULB in it. States and ULB should allow the SPV to operate independently to access resources. It can also be done with Public-private partnership, turnkeys etc. Funds should be in a 50:50 ratio manner between states and ULB and they will have control over the SPV than PPPs. Grants should be as per conditions lead down by the MoUD.

3.6 Financing of Smart cities

SCM is a Centre sponsored scheme, the Union Government proposes to give funds to this mission about an average of Rs.100 crore per city per year. The project cost is based on the cities ambition, execution and repaying capacity. And some balanced to be collected from user fees and Impact fees.

3.7 Some Smart city projects already in implementation

- Chandigarh - Union Territory - Retrofitting model - 114 km².
- Gift city - Gujarat International Finance Tec-city - Greenfield development model - 3.99 km².
- Wave city - Ghaziabad (NCR) - Greenfield development model - 18.21 km².
- Lavasa city - Pune - Greenfield Development model - 100 km².
- Palava city - Thane - Greenfield development model - 18.21 km².

3.8 Agreements under Bilateral technical collaborations

- Delhi Development Authority (DDA) smart city project with Barcelona.
- United States Trade and Development Agency (USTDA) adopted three cities – Ajmer, Prayagraj and Vishakhapatnam.
- Varanasi - Kyoto (Japan) Agreement.

3.9 Policies on Urban development by Government of India

- Atal Mission for Rejuvenation and Urban Transformation (AMRUT).
- Heritage City Development and Augmentation Yojana (HRIDAY).
- Swachh Bharat Mission (SBM).

4. SMART CITIES OF THE WORLD

4.1 Smart Amsterdam

Amsterdam is the capital and the most populous city of the Netherlands, of North Holland province. It is attributed by the large number of canals which are UNESCO World Heritage Site. It is about 2 metres below sea level. It also has a man-made forest Amsterdamse Bos in the Southwest. It is one of the pioneers of smart city concept in Europe about 2009 itself. It adopted the bottom-up methodology. Its aim is to achieve a smart economy, smart governance, smart living, smart mobility and smart people.

4.1.1 Amsterdam smart initiatives

4.1.1.1 Almere smart society: It is a project to create a 'smart society' by Almere Economic Development Board in collaboration with IBM, Cisco, Philips, Liander and Living PlanIT smart city. It uses the Internet of things (IoT) in urban management and development that involves people and natural resources to promote urban management, economic growth, innovation in sustainable development.

4.1.1.2 Smart Lighting: It is one of the most common initiatives in all the smart city projects to make street lights as smarter one making street light not only as a street light and also Wi-Fi connectivity, weather predictor and a digital information board etc. In Amsterdam, Alliander, a Dutch utility firm teaming up with Cisco and Philips to create a smart lighting project. It included sensors that light up according to weather, temperature, coloured lights to guide pedestrians, public Wi-Fi network to the street lights.

4.1.1.3 Vehicle2Grid: A collaboration of Amsterdam smart city with ABB, Cofely, Mitsubishi Motors, ABB, Amsterdam University of Applied science to promote and implement the smart electric vehicles in the city. Users able to use the battery to store their locally produced energy to run household appliances or electric vehicles.

4.1.1.4 Bio-based materials: Street benches used by the citizens in the park, playgrounds and Street signs are made up of Biocomposite materials.

4.1.1.5 Smart city academy: A local social platform was created through which the citizens can share their experience with smart innovations in the city by the way of storytelling and it is used to create awareness among other citizens.

4.2 Barcelona smart city

Barcelona is a city on the coast of northeastern Spain. It is the second-most populous municipality of Spain. Its area consists of so many small hills. In 2015, new mayor Ada Colau made a new move on the city's smart city mission by engaging a large number of its citizens in development. It is a democratic way of smart city creation hence it is called as a Barcelona smart city - By the people, for the people. This initiative geared up after recruiting Francesca Bria as the Chief Technological Officer of the city. She made it ground-up methodology rather than a technology push strategy.

4.2.1 Barcelona smart initiatives

4.2.1.1 Bicing: It is a public transportation sector initiative by making a public bicycle sharing. Over 6000 bicycles are provided for the public use in bicycle pickup stations in various places near bus stops, railway stations, parks, playgrounds. A mobile application was created called Bicing app, using these app citizens can access these bicycles and pay fees for their usage annually.

4.2.1.2 Orthogonal bus system: An orthogonal grid system, by creating bus stops in a particular place that allows connection between bicycle pickup points, cities metro stations, trams etc. Hence every kind of transport is interlinked with one another so citizens can easily reach their destinations.

Those bus stops are solar-powered equipped with solar power applications and digital boards.

4.2.1.3 Smart parking spaces: In the parking spots, there are sensors placed underground and connected with an app, using these citizens can know the empty parking spots easily and park their cars without roaming here and there to find the empty parking spots. Later the underground sensors are replaced with infrared sensors due to some technical problems.

4.2.1.4 Waste management system: Smart bins are placed that can detect the amount of garbage in it and notifies sanitation workers when the bins are filled. And also using these the workers can make their collection routes according to the priority. Some smart bins are connected to the underground vacuum suction pipe system they collect a number of bins garbage to repositories and reduces the smell of garbage. These waste are used in producing energies for city's heat system.

4.3 London smart city

London is the capital and largest city of England and the United Kingdom. This city is located on the south-east of England and in the bank of River Thames. It is also called as greater London. London is the tech capital of Europe. The smart city board of London was established in 2013. It promotes the participation of the public sector and also the private sector in developing the smart city mission. It aims at user-friendly, Digital smart world. Its initiatives are collectively called as Smarter London Together.

4.3.1 London smart initiatives

4.3.1.1 London data store: It is an initiative for making data openly accessible to all the citizens using a data-sharing platform. The citizens provide the data on certain datasets like safety, health, job, economy, housing, transport etc. It contains 700 city datasets available to the citizens for free access. It also helps public service sectors to predict service demands.

4.3.1.2 Advanced transport system: This project mainly concentrated near Heathrow airport, one of the busiest airport in the world. An initiative of Ultra global part called a Heathrow pod system, is a zero-emission rapid transit system connecting the terminals with the parking and pickup spots. It consists of 21 public pods that replaced the bus transport inside the airport.

4.3.1.3 Mission combating pollution: The street lights are provided with air quality sensors that regularly monitor the air quality in its surroundings. Google street view cars are introduced that periodically record the smog in high polluted roads.

4.3.1.4 London green city initiatives: Smarter London board set target to use 100% renewable energy by 2021, zero-emission vehicles by 2025, reduce waste by 50% by 2021.

4.4 Singapore smart nation

Singapore is city-state Sovereign Island in Southeast Asia. It consists of 63 small islands. It has less forest cover and also high pollution. The Singapore government made smart city initiative to make the environment suitable for living in future. It also took the public private-partnership model to create it a smart nation in a shorter period. It announced its smart city mission in 2014. In 2018 Singapore became one of the smartest cities of the world. It also named as the smartest city in 2018.

4.4.1 Pillars of Singapore smart nation

4.4.1.1 Digital Economy: Singapore government decided to turn the nation into a digital economy. In 2018 to increase its foreign investments it made a collaboration with Infocomm Media (ICM), the thinktank behind the Singapore digital economy.

4.4.1.2 Digital Government: It put forth an idea called digital to the core i.e. to digitalize every action in the country that cut shorts delay and waiting. It involved government actions also as a digitalized one. It made every action on e-governance.

4.4.1.3 Digital Society: Not only the transaction and governance digitally even the citizens every activity turned digital. It termed a definition called Digital literacy - the ability of the people to use modern technology. It also created special programs to increase the awareness of digitalization among the people.

4.4.2 Singapore smart initiatives

4.4.2.1 CODEX: Core Operations Development Environment and Exchange, an initiative to provide digital services to its citizens quicker and cost-efficient. It creates data sharing agencies in between to reduce the burden of the government.

4.4.2.2 Smart nation sensor platform: It is a platform to make effective urban planning, services, to improve transport, safety and security by using data transmission by sensors. It set up a team to create hotspots for the placement of sensors to make this initiative successful.

4.4.2.3 Moments of Life: A single platform developed for citizens to get some selected services easily and quickly. Some of the services are citizens can register the birth of their child, to apply for benefits, and can to locate the playschools, even they can register in the same platform, and also can access their children immunization records and updates.

4.4.2.4 Contactless fare payment for all public transports: A common fare payment RFID card is provided to the citizens using which they can pay the fare in all public transports like buses, metros, trams etc. This contactless uses Radiofrequency Identification and deducts the amount automatically when they pass through the sensors. Citizens can top-up their smart cards whenever they need.

5. CHALLENGES IN DEVELOPING AND IMPLEMENTING SMART CITY MISSION IN INDIA

5.1 Financing the smart cities

However the mission is the public-private partnership model, the centre has to fund for the development of 100 cities at a time. Initially, urban development is handled by their state-owned funds it is a golden opportunity for them to rejuvenate in centre funds. But for the centre, it is a huge burden to provide fund at a time to 100 cities development.

5.2 Financial sustainability of ULBs

The tariff levels fixed by the ULBs are low they cannot be sufficient for projects in a wide range. Even though it is a collaboration project additional investments should be managed by ULBs otherwise it may lead to financial losses.

5.3 Availability of master plan or city development plan

Most of Indian cities (70% to 80%) does not have a master plan or city development plan. It is the key to the planning and implementation of smart city mission.

5.4 Retrofitting existing areas

Most of the cities will adopt the retrofitting model as they have outdated infrastructures in them. To identify them and provide a suitable technique is the many blocks in front of those cities. It leads to pan-city development in larger boundaries. Identifying and providing solutions for them is the most complicated one to overcome by this mission.

5.5 Three-tier government

India is made up of an integrated and step governance consisting of three tiers - Union, State, ULBs. The effective coordination between these bodies can make this a successful project. The communication and relationship between these bodies and also with the privates that enter into this mission decide the successful percentage of this mission.

5.6 Clearance in timely manner

To finish this project without any time delays, all clearance process should be given in a timely manner. The effective way to achieve this is the online process to submit reports, analysis and to provide clearance certificate. A regulator body also should be set up to manage and monitor these activities.

5.7 Capacity building

The delay of projects may occur mainly due to lack of quality manpower. According to the Indian smart city mission only 5% is allocated to the capacity building program. But the reality is investing in the capacity building will make the project cost-efficient and reduce time delays.

5.8 Availability of resources

Cities should be shifted towards renewable energy. But while on making process it depends on some other resources. The availability of the resource also plays an important role in achieving the goal of the mission. The cities also should be provided with uninterrupted power supply, water supply and Connectivity.

6. SMART SOLUTIONS

The cities should mainly focus on providing smart solutions on

- Water management,
- Waste management (Both solid and Liquid Waste),
- Energy management,
- Transport management,
- Health services,
- Government and public services.

6.1 Use of Information and Communication Technology (ICT)

It is the most emerging technology in the service sector, it employs the most population in it. Often it helps in every way from buying things and tickets online to attending seminars online. It reduces resources, time, pollution etc.

6.2 Role of IoT and Machine to machine (M2M) in smart cities

Artificial Intelligence is a combination of automatic data collection by IoT and M2M. By this data is transferred from initiation area to storage by the machine itself without the help of humans. IoT helps to provide the service based on the demand that reduces resources on unwanted services.

6.3 Smart Metering

Water supply, gas supply, electricity supply are metered through smart applications reduces the work of human by the automatic quantity of usage and its tariff displayed on the meters. It also helps in the conservation of these resources.

6.4 Smart Transportation

Automatic traffic control system, interconnected public transport, easy accessibility, ecofriendly transport system like zero-emission systems and electric vehicles. Traffic control systems should be made that helps in avoiding traffic jams, accidents, congestions etc.

6.5 Overall data collection and storage

The collection storage every data that provide in the cities may be useful in many ways to find solutions. The handling of massive data needs more skills and resources to store.

6.6 Use of clean technologies

As per WHO reports Indian cities are most polluted cities in the world. This creates more health issues to the citizens. The trend should be set to reduce the environmental footprints by lowering the emission of CO₂, Reduce deforestation, use of renewable resources.

6.7 Renewable energy

India should move towards renewable energy like solar energy, wind energy, Tidal and Hydro Energies from Thermal and fossil energies.

7. IMPLICATIONS TO PRACTICE AND POLICY

- Roll of better governance and efficient decision and policymaking.
- Management of resource in developing the infrastructures.
- Introduction of new technologies.
- Awareness among people.
- Conserve biodiversity and increase ecological performance.
- Achieving sustainable development goals.

8. CONCLUSION

Smart city researches all over the world are increasing in recent times as it is the need of the century to conserve their resources as well as to technological advancement. It includes the issues of citizens daily life, Governments daily activities etc. This has diverted the researches and planners to contribute something to improve or solve these problems and tensions. The existing situations create stress for everyone that affects the people both mentally and psychologically. In these problem arising environment this project smart city mission is an opportunity to safeguard our environment with the technologies. Technically it is a project to make the environment to most livable one. The increasing population all over the world needs to consume more resources if we continue to consume the natural resource in this speed our next succeeding generation itself won't have any left for them. Literally, it is also a resource-saving project as it tends us to move towards renewable energy sources. The challenges before us are population increase, the concentration of population in a particular area, over consumption of natural resources. It cannot be concentrated and tackled by a single way or by a single country or organization. One country can make the best solution for one problem or challenge another can make for one, so by interchanging the data's and ideas is the only way to solve these challenges as soon as possible. Setting up a model for one by taking other as a model is the best way to get efficient results. Everyone will be role model for any other in any one of the task in this mission. The first step in selecting the cities for Indian smart city mission itself taught us the inclusive growth, challenging and learning from each other, and also it made independent of creating proposals of their own because it is not 'One fit for all'.

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