

Urban Transformation for India @ 2047

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Abstract

India is moving to become a developed country by 2047, It would be one of the World's largest economy and urbanisation shall be its backbone. The Government of India has undertaken several missions of urban development, PM Gati Shakti Master Plan (2021), Waterways, Highways and Golden Quadrilateral, Railways and Metro Networks, Amrit Bharat Railway Stations, Urban Development Infrastructure Development Fund (2023) and National Monetisation Pipeline (2021). These initiatives are writing a new script of urban development and provide some key lessons for transforming the urban sector.

Keywords: Sustainable Development, MissionLiFE, Outcome based Planning, PMGatishakti , ICT Enabled Planning ,Integrated Command and Control Centre.

Introduction

In India 7935 cities and towns accommodate 377 million people, i.e. 31.16 % of total population. (Census 2011). 475 Class I cities constitute 42.63 per cent of the total urban population. 3 mega-cities, viz. Greater Mumbai (18.4 million), Delhi (16.8 million) and Kolkata (14.1 million) have crossed the 10 million population mark, while five cities, viz. Chennai, Bengaluru, Hyderabad, Ahmedabad and Pune have more than 5 million population. From 432 million urban population in 2021, it is projected that by the year 2047, 820 million people in India will live in urban areas (Table 1).

Table 1: India's Urban Trajectory

Year	2011	2047
Population	1210 million	1640 million
Urban Population	377 million (31.16%)	820 million

Cities and Towns	7935	-
Million + Cities	53	=

Sources: Census of India, 2011, and UN

In 2047, India with a sixth of world's population will be most populous country. It will have the world's largest workforce and will be the world's third largest economy. According to Knight Frank, India's economy in the year 2047 shall expand to \$36 trillion. With 50% of its population below the age of 25, India has the world's largest work cohort. The ongoing process of urbanisation is vital for economic growth as in 2047, 75% of GDP and new jobs will be created in the cities. This needs transformational policies of urban planning and development. It also requires a review of the legal structures for a decentralised urban governance. Decentralisation needs localisation and participation, which lead to inclusivity. The 73rd and 74th Constitutional Amendment Acts in 1992-93 empowered the urban local bodies to prepare District and Local Plans, and constitution of District Planning Committees and Metropolitan Planning Committees. However, many States did not abide by these provisions and perpetuated with State Government controlled Master Planning. After 30 years, it is time to revisit the 73rd and 74th CAA.

Sustainable Development Goals

The concept of 'sustainable development' was defined in the 1987 Brundtland Commission Report as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987). The 'sustainable development' has become a paradigm for integration of environmental, social and economic considerations (Fig. 1).

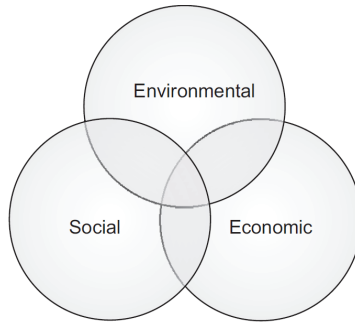


Figure. 1: Classic dimensions of sustainable development

The UN General Assembly in September 2015 adopted the Sustainable Development Goals. The 2030 Agenda signed by 193 countries, including India covers 17 Sustainable Development Goals and 169 targets (Fig.2). Goal 11 of the SDGs focuses on making cities and communities inclusive, safe, resilient and sustainable. Goal 13 of SDGs calls for combating climate change and its impacts. There is a clear shift in the paradigm of development, which aligns with its humane, economic, environmental, cultural and social aspects. The focus is upon protecting the rights of the poor, informal sector, women and vulnerable communities and provide them with housing, water, sanitation, electricity and jobs. It combines human and physical geography by interaction between society and natural environment (Fig. 3). The Sustainable Development Goals envisage a shift from linear unsustainable system of a mega city to a circular, sustainable eco-city (Fig 4).



Figure. 2: Sustainable Development Goals

Source: United Nations, 2016

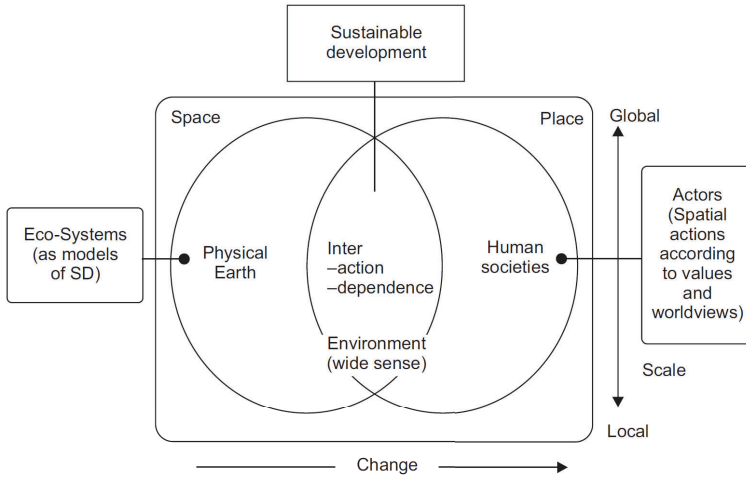


Figure. 3: Sustainable development combines human and physical geography by the interaction and interdependence between societies and their natural environment at different spatial scales

Source: UNESCO-MGIEP (2017)

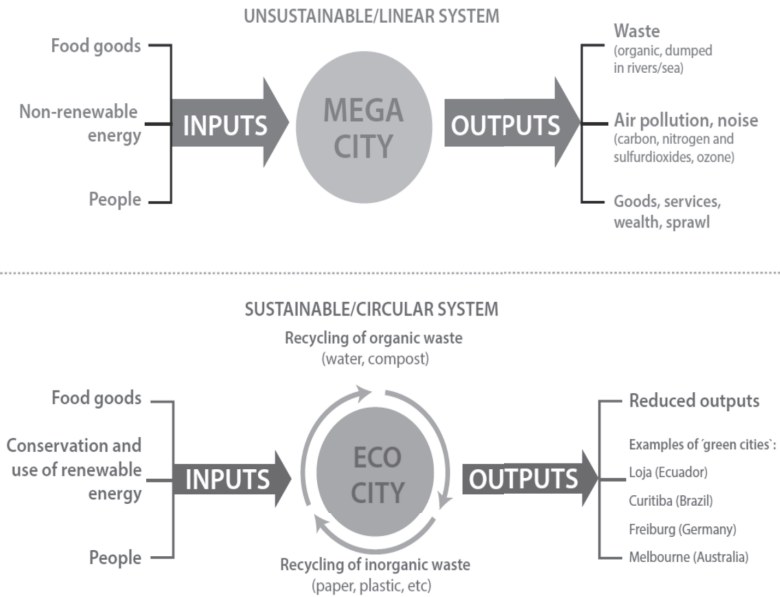


Figure. 4: City as a System

Source: UNESCO & MGIEP (2017) Textbooks for Sustainable Development, A Guide to Embedding, UNESCO and Mahatma Gandhi Institute of Education, Peace and Sustainability, New Delhi

Carbon neutral buildings, energy and transport without the use of fossil fuels make the built environment sustainable and energy efficient. Trigeneration energy systems, dual piping for recycled wastewater, water saving toilets and taps, and satellite controlled micro-irrigation cut water and power consumption. Three bin recycling with separate bins for trash, recyclables and compost, enzyme based STP, bio-remedial treatment, sludge gas/energy recovery, vermi-culture, fossilization and composting options are elements of sustainable waste treatment. Swales, porous paving, bio-drainage and storm surge gates in river, drains and canals and zero run off drainage, conserve water and save human settlements from floods. Rooftop solar panels generate electricity instead of power plants and reduce city's heat build-up. Rooftop vegetation, insulation and super-insulated glazing can ensure the building's thermal performance. Smart glass technology and district cooling system with cool air draughts in subterranean clay pipes, save on air-conditioning and energy. These help in reducing the ecological footprints, formation of heat islands and pollution.

According to the Census 2011, about 17.4 percent of India's urban population, i.e. 65 million are living in the slums. By and large, the poor live in unplanned, basti, hutments, slums, on the pavement, in dilapidated buildings, irregular colonies, etc. For an equitable city, it is necessary to address together the livelihood and shelter issues of the informal sector including the women, children and homeless. These involve some basic changes in policies, planning and infrastructure services.

The LiFE or Lifestyle for the Environment Mission (2022) aims at low carbon lifestyle embedded in social behaviour and habits that minimize the use of natural resources, and emission of wastes and pollution. Creating sustainable lifestyle requires a change in social norms and the ways of living based on the principles of organicity,

non-accumulation (*aparigraha*), minimalism and slowing down. It is about caring, sharing, recycling, reuse, repairing and retrofitting for a balanced natural environment. This means adoption of circular economy and systems, which are restorative, regenerative and minimise wastes (Fig. 5).

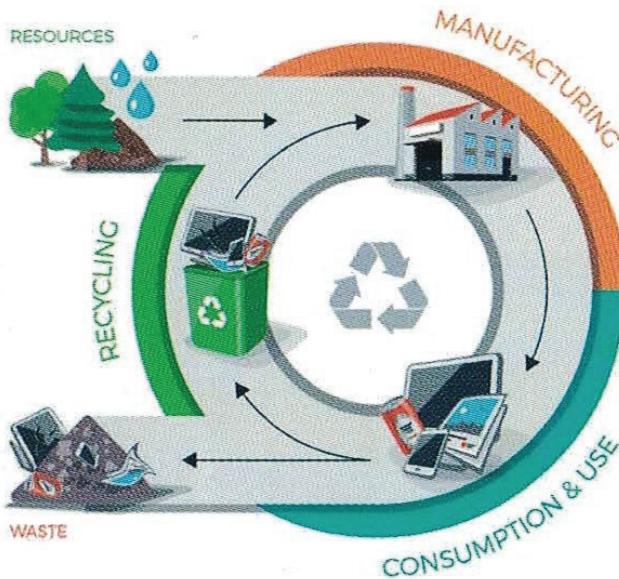


Figure. 5: Circular Economy is Restorative, Regenerative and aims at minimising wastes and making the most of resources

Source: Khan, Khalil Uttah (2022) Wastewater Reuse, Linear Economy to Circular Economy, Shashwat, TERI, New Delhi

National Urban Policy Framework

The National Urban Policy Framework (NUPF 2020) envisions ‘urban areas with distinct identity providing ease of living, responsive governance, sustainable environment, rapid economic growth and livelihood opportunities for citizens. It envisages that the States and ULBs adopt the following core principles of Outcome-based planning and funding:

- Integrated: One City – One Program – One Fund
- People-centric: Citizens First-Project Next
- Collaborative: Promotes Partnership between Centre-State-Local Governments

- Inclusive: Open to all States and Cities
- Demand Driven: States and Cities Decide the Outcomes they want to achieve
- Based on End Results: Promotes ‘Function’ Over ‘Form’
- Equitable: Uses Objective Formulae to Determine Funding
- Encourages Commercial Financing: Raise More, Gain More
- Objective: Promotes Independent Performance Evaluation
- Data Driven: Supports Evidence-based Decision Making
- Transparent: Public Disclosure and Citizen Engagement
- Fosters Innovation: Do More with less
- Builds Capacity: Promotes Learning by Doing
- Reorients Government Role: Shifts from Driver to Facilitator

The NUPF follows a ‘loose fit, light touch’ approach with the adoption of Circular Systems of sustainable development for a balance between economic growth and conservation of ecology.

National Geospatial Policy (2022)

National Geospatial Policy notified in 2022 by Ministry of Science and Technology is the basis of sustainable planning, land management and disaster risk reduction. It seeks to enrich the geospatial data by the following programmes:

- High resolution topographical survey and mapping (5-10 cm for urban and rural areas and 50 to 100 cm for forests and wetlands)
- High accuracy Digital Elevation Model (DGM) for the entire country (25 cm for plain and 1-3 m for hilly and mountainous areas)
- Enhance capabilities, skills, and awareness to meet the future needs of the country
- High resolution geospatial data of water and topography and geospatial features
- Survey and mapping of sub-surface infrastructure in major cities and towns
- Advance Application Programming Interface (API) that allows software to talk to each other and develop digital solutions.

Under the Geospatial Policy 2022, 3D Digital Twins allow collecting and creating content in partnership with the ESRI India. It provides a technology platform for 3D modelling and virtual representation of an object or a system that uses sensors, drones, 5G Internet of Things (IoT) and industrial IoT (IIoT) data. It applies advanced analytics, machine learning and artificial intelligence (AI) to derive real time insight into the performance, operation and sustainability of a project or a city. These cover critical areas of sustainability, such as buildings, energy, low carbon zones and tri-generation energy systems (combining power, cooling and heating).

India's Urban Missions

The Government of India in 2014-15 launched several urban missions, viz. Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Pradhan Mantri Awas Yojana, Historic City Development and Augmentation Yojana (HRIDAY) and Swachh Bharat Mission (SBM). The Smart Cities Mission envisages development of 100 smart cities which are infused with intelligence, integrity and inclusion with state of art infrastructure services, transport and housing for all.

The Atal mission of Rejuvenation and Urban Transformation (AMRUT) has covered more than 5,800 projects related to water, green space and mobility. The Pradhan Mantri Awas Yojana Urban (PMAYU) is nearing the target of building 12.2 million houses. The Swachh Bharat Mission (Urban) (SBMU) tackles urban sanitation and waste management, having provided a record 9 million toilets. The plans under these missions are based on digital planning via computing processes with net zero energy, water and waste together with circular systems.

The PM Gati Shakti Master Plan, launched in 2021, focuses on next generation sustainable infrastructure for seamless movement of people, goods and services. It leverages new technologies in planning, breaking the silos of departmentalisation to achieve ease of doing business. It has coordinated with the Indian Space Research organisation (ISRO) for spatial planning, engaging BiSAG (Bhaskar Acharya National Institute for Space Applications) and Geo Informatics. This GIS platform builds over 1200 data layers from Central Government Departments and 755 from the States/Union Territories.

Multi-modal integration, last mile connectivity and e-governance are the pillars of PM Gati Shakti Master Plan. All the modes of goods and passenger

transport, including buses are digitised and pooled, and adopt Intelligent Transport Systems and transit-oriented development.

Both the Smart Cities Missions and Gati Shakti Master Plan are for a horizon of 5 years replacing the 20-year colonial model of Master Planning. The circular economy and new technologies, such as digital blockchain, combinatorial and discrete optimisation, algorithms, complexity theory, artificial intelligence, big data, ubiquitous cloud and hash algorithm enable planning and integration of services (Fig. 6).

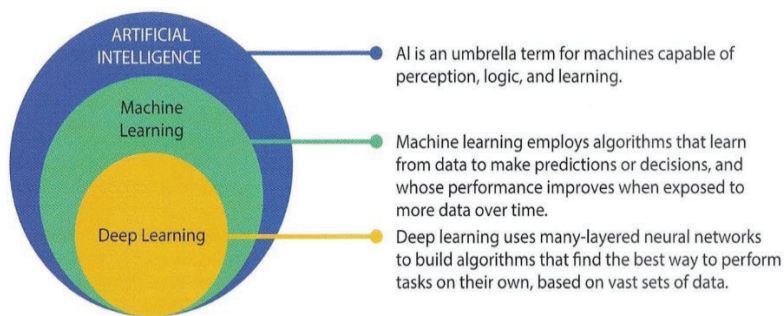


Figure. 6: Components of Artificial Intelligence

Source: Verma, Seema, Towards Data Science, Shashwat (2022) TERI, New Delhi

The National Monetisation Pipeline has a budget of Rs 6 lakh crore during 2022-25, of which the share of the Railways is Rs. 1.52 lakh crore. Railways Infrastructure Investment Trust (InvITs) is being anchored by the Dedicated Freight Corridor Corporation (DFCC) for redevelopment of railway stations, warehousing, commercial and entertainment hubs. In the budget (2023-24) 1275 railway stations are being redeveloped through EPC contracts. The funds have also been allocated for Rapid Train Projects, Railway Bridges, High-Speed Railway Corridors, Dedicated Freight Corridors (3581 km), Hydrogen Powered trains, Gati Shakti Units and Transit Oriented Development.

The investments go hand in hand with innovations, viz. digitisation of railway supply chain, artificial intelligence, biometric token system, contactless travel, driverless train operation, head on generation system, LIDAR technology, online monitoring of rolling stock, cyber security and Kavach safety technology.

Imperatives for Indian Economy

A paradigm shift is visible in the budget 2023-24 approved by the Parliament in February 2023. As given below, it articulates a 7-imperatives, viz. saptrishi that aims to lead the Indian economy on a resilient, circular and green path of development:

- Inclusive development
- Reaching the last mile
- Infrastructure and investment
- Unleashing the potential
- Green growth
- Youth power
- Robust financial sector

The budget has emphasized on panchamrit, viz. LiFE (Lifestyle for Environment), National Green Hydrogen Mission, Gobardhan (Waste to Energy Plants), Mangrove Initiatives for Shoreline Habitats and Tangible Income (MISTI) Scheme, and Vehicle Scrapping Policy.

In the budget an Urban Infrastructure Development Fund has been established to incentivise the cities to improve their finances and make them ready for municipal bonds. This will encourage the urban local bodies to tap the market capital and to improve their performance. This would also help in creating a business-like work culture and a spirit of competitiveness among the local bodies in India, making them credit worthy.

The urban infrastructure financing can be addressed to a great extent through Value Capture Finance (VCF). The Smart Cities Mission has identified various sources of land-based financing and monetisation. The McKinsey report estimates that nearly 45% of the urban financial requirements can be met through various land and asset monetization strategies, such as development charges, impact fees, building fees, land use conversion charges and sale of Floor Area Ratio (F.A.R) or air rights.

In several cities, where space is locked under the transport and railway corridors, air rights can be sold to enable its efficient utilization, besides generating revenues for the urban projects. The CIDCO has developed commercial office space above suburban railway stations in Navi Mumbai.

The RLDA has redeveloped Gandhi Nagar Railway Station with a five-star hotel.

To encourage optimum use of land and densification by higher FAR, a two-tier FAR structure can be adopted with a basic FAR bundled with property right and the remaining to be purchased to enable value capture. This has been used to subsidise in-situ slum rehabilitation, whereby 40% of land/FAR for market sale finances the whole project, e.g. Kathputli Slum Rehabilitation Project in Delhi.

Impact fees are levied on new constructions in an area where large public investments such as major roads and highways, metro rail, industrial corridors, ports, airports, and other public infrastructure are undertaken. An example of impact fee is new developments within the 1 km wide Growth Corridor (GC) on the 162 km Outer Ring Road (ORR) around Hyderabad. The impact fees are higher for commercial use, and increases with the FAR. However, there had been a wide gap between the estimated and actual recovery.

Engagement with Industry 4.0 Standards and Digital Public Infrastructure

During last decade, new age technology has changed the script of urban planning and management. As demonstrated by Smart Cities Mission and PM Gati Shakti Master Plan, the new technology is vital for delivery with speed, scale and skills. The ICT (Information and Communication Technology), Artificial Intelligence, Big Data Analytics, Machine Learning, Deep Learning, blockchain, GIS, GPS, etc. are disrupting the urban processes by intelligent and smart planning, infrastructure and services, transport systems, land management and enforcement. Digital India, National Digital Urban Platform and Urban Platform for Delivery Online Governance (UPYOG) are leading to digital municipal services with speed and without bureaucratic red tape.

The MOHUA and NIUA, along with the Bureau of Indian Standards (BIS) have developed 15 Smart City Standards. These focus on the use of new technological systems, such as GIS, sensors and networks. The Unified Digital Infrastructure – ICT Reference Architecture Standards (IS 18000:2020) is a comprehensive document for digitalization of urban practice. It defines the “Unified Digital Infrastructure” as the sensors, data systems, IoT systems and platforms. Smart Cities – GIS (IS 18008: 2020)

standards define key formats for GIS platforms; and Unified Data Exchange Standards lay out the architecture for instituting data exchanges or marketplaces.

The breakthrough in digital technology and informatics has multiplied space, energy and time. It is time that new forms of energy, services, construction and recycling are evolved, which are characterized by online exchange of information, interactions, dynamic networks and floating nodes. Global positioning systems and satellite-guided GPS devices are increasingly being used for urban surveys, planning and laying of services. By data analytics, the planners can plan and implement the projects with precision and accuracy. Integration of land use, utilities, transport and building on a common network helps optimize space efficiency and energy use. By developing sector-focused, cluster-based intelligent city strategies, territories can set in motion innovation mechanisms and enhance sustainability of their services and systems.

According to NASSCOM- McKinsey Report ‘Sustainability Opportunity for Tech Services and Solutions’ (2022) digital technologies such as Cloud, IOT, Blockchain and AI (Artificial Intelligence) can be critical in evolving sustainability solutions, energy management, real estate and buildings which end up benefitting bottom lines and accelerating deliveries. It is estimated that during next 25 years, the number of buildings in India will be multiplied six times. These have to be net zero and energy efficient. This involves upgrading the power monitoring system, unlocking renewables, smart waste management/recycling with easy to digest dashboards. These provide real time measurement of power load at the circuit and building level to make it net zero and climate resilient.

An intelligent geo-portal can bring together various line departments and communities on a platform for e-service delivery. The system is mobile and internet based, dynamically scalable. It helps in technology enabled management of land and infrastructure, planning and development. This yields better co-ordination and exchange of information, cost and time management. Citizen engagement becomes much easier and viable by virtual town halls.

Smart chips and systems can be embedded almost in every urban service and structure, making them smart and intelligent. With digital chips cities are increasingly getting digitally scripted and coded. The “smart nodes on a smart grid” concept can be used to provide services to enhance users

experience, such as high-speed communication and data management, carbon-emission accounting and performance objectives. This implies integration of green concepts with new technology.

ICT Enabled Planning and Design

The ICT can be a game changer in this transition towards a green and clean economy, smart, resilient, and low carbon infrastructure services, transport and community. The ICT can help in the integration of citizen participation, governance and online consultation over plans and programmes of local development. Thus, the city plan needs specialised inputs from domain experts in GIS, GPS, EIA, SDI, big data analytics, ERP solutions, digital dashboard, blockchain, etc. Some key areas of ICT enabled fields are shown in Table 2.

Table 2: ICT Enabled Planning and Design

	ICT Enabled Fields	Key Areas
1.	Planning, Design and Construction	CAD and CAM enabled Planning, Design and Construction Integrated Digital Planning, Conservation of Land, Natural Resources, Heritage and Environment GIS, GPS, Remote Sensing, Total Station/Drone/Satellite Surveys, Photogrammetry Big Data Analytics, ERP Solutions EIA, Heritage/Transport Impact Analysis, Experience Simulation, Concept Generating Matrix, Morphological synthesis, LiFE Platform, Digital Ledger and Dashboard Environmental Management Smart Building, Parametric Design, Morphotectonic Strategies, Animation, Simulation, Algorithm and Equations, 3-D Modelling, Digital Fabrication, Morphogenic Geometry, Biomimicry, Adaptive Systems, NURBS Curves and Surfaces, Spline Topology, Voronoi, Genetic Computation, Fuzzy Logic, Robotics, etc. Building Information Modelling

		Digital Land Information System, Digital mapping, SDI, Geo-portal, GIS based property records, plans and transactions Online building plan approval and clearances
2	Land Management	Digital Blockchain, Land Administration Digital Model (LADM) Accommodation Reservation, Transferable Development Rights, etc.
3	Energy	Common Digital Platform Energy networks, smart grids, Smart meters, Smart buildings Renewable energy Electric vehicles, Green Hydrogen Power quality monitoring Energy conservation, Storage and efficiency Bionic Controls, Passive Evaporative Draught Cooling, Earth Air Tunnel, District Coding Intelligent management/maintenance, MIS
4	Public Utilities	Realtime Digital Platform SCADA (Supervisory Control and Data Acquisition) ERP Solutions Intelligent water and sewerage networks with minimum losses and leakages Intelligent metering, billing and payment Waste Recycling Plug the Non-Revenue Water (NRW) losses Identifying leaks using non-invasive techniques and advanced analytics by managing the pressure in the network at pumps and valves, which reduce energy consumption
5	Smart mobility	Transit Oriented Development Real time congestion information Simulation modeling and analysis Smart cards, driverless vehicles Smart signals, traffic controls, variable signage, mobile enabled real time maps/routes, way finding, etc. ICT enabled traffic control, vehicle safety, communication, Dynamic Regional Network Modelling, multi-modal integration

		Safety and security, accident monitoring, forensic analysis Infrastructure integration, Smart City Pole Digital Taxi/Car/Bus/Auto Pools Maintenance, MIS and management
6	Intelligent Community Frameworks	Digital Intelligent Community Planning Networked Education, Health, Recreation and Other Facilities Digital Data on Residential Types, WFH, Hostels, Night Shelter, Social Rental Housing, etc.
7	Disaster Management	Early Warning System, Emergency Aid, Rescue, Relief, Repair, Restoration and Reconstruction, Medical Aid, Life Support, District Hazard Risk Map Integrated Command and Control Center
8	Telecom Networks	Broadband development, home automation, Internet access, ICT support and training Public Security System and Safety Consolidated billing Business incubation center, Climate Street, Electronic trade office, City Administration, Technology and Innovation Centre Geo-portal, mobile based supervision and control
9	Urban Management	Collapse of Hierarchical Management Structure Planners to have a Shorter Shelf Life unless they Refresh and Rebuild A Shift from Long Range Planning to Strategic Planning Interdisciplinary teams.

National Data Analytical Programme and National Urban Digital Mission (NUDM)

The Niti Ayog has built National Data Analytical Platform which provides data sets in machine readable formats. This can be used for planning and policy making such as Aspirational District Programme. The Ministry of Housing and Urban Affairs (MOHUA) in February 2021 launched the National Urban Digital Mission (NUDM), which aims to push for the outcome based digitalization of urban planning and governance.

The urban data acquisition, analysis, and solutions have received a significant push from the Data Acquisition and Exchange Programme. It enables data to be exchanged, analysed and marketed on specific platforms. To enhance capacity efficiency and transparency in urban sector, various portal such as India Urban Data Exchange, National Urban Learning Platform, and Smart Code have been launched while the National Urban Governance Platform is under development under National Urban Development Mission.

National Urban Innovation Stack (NUIS) is part of the agenda of digitalization and datafication by creating certain design principles, defining digital components, platforms and standardization. The creation of a “shared digital infrastructure” aims at systematically organizing India’s urban data and employing it for a variety of purposes. The NUIS is a collection of cloud-based services, which provide a single capability across multiple urban services, accessible through simple, open APIs compatible with global standards and specifications. Together, these services and standards create a powerful framework to drive convergence and a faster implementation cycle.

The MOHUA has established several assessment frameworks to measure the progress of digitalization and datafication in cities over time. The Data Maturity Assessment Framework (DMAF) and the Integrated Command and Control Centre Assessment Framework (IMAF) have been developed for the centralized monitoring and evaluation of datafication in cities.

The Centre for Digital Governance (CDG) has been established in the NIUA in 2020 to create policies through research, digital infrastructure, platforms, partnerships, and act as an advisory body for the cities. The CDG is guided by two committees, the City Data Alliance (CDA) and the Smart Cities Advisory Forum (SCAF), which are composed of citizens, academia, industry, and municipal agencies.

The Data Analytics and Management Unit (DAMU) coordinates with the cities on datafication, advises cities on data analytics and legal frameworks, creates case studies, and reviews progress of cities’ use of data in governance. The SPV hires Project Management Consultants (PMCs) for Area Based Development (ABD) Pan City Projects (PCP), civil infrastructure and digital projects.

Integrated Command and Control Centre

The Integrated Command and Control Centre (ICCC) is one of the key projects of the cities under the Smart Cities Mission (Fig. 7). The ICCC coordinates multiple municipal functions, disaster management, transportation, weather, and emergencies.

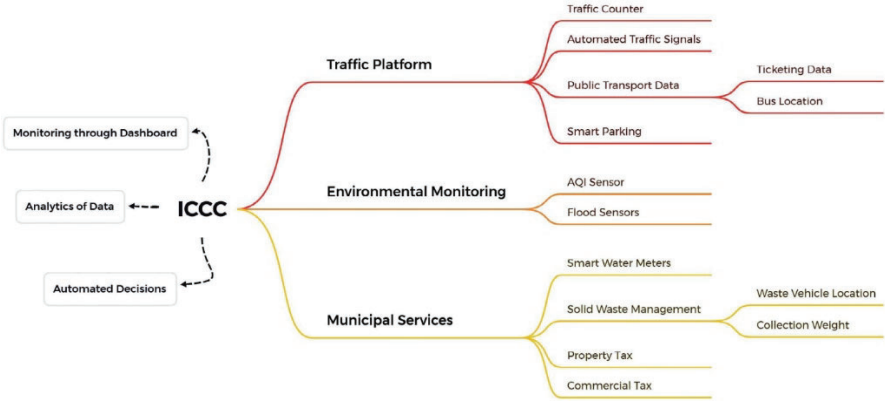


Figure. 7: Model of the Integrated Command and Control Centre (ICCC)

Source: Parkar, Khaliq and Uttara Purandare (2023) Decoding Ditzitization of Urban Governance in India, Centre for Policy Research, New Delhi

Disaster Risk Reduction (DRR)

At the international level, India has been playing a leading role in the field of disaster risk reduction. As announced at the Sendai framework review meeting at the United Nations in May 2023, India has set the priorities of DRR for G 20 Nations, viz. early warning for all, resilient infrastructure, improving finances and capacities for DRR response and eco-system-based approaches. The use of new technologies is indispensable for the disaster risk reduction, as given in Table 3:

Table 3: New Technologies for Disaster Risk Reduction

Phase	Activities	Example Technology
Mitigation	Geospatial data of built environment	Remote sensing for documentation all the

	<p>Baseline information of natural ecosystem</p> <p>Land use planning and risk management</p> <p>Community engagement</p>	<p>buildings, location, age, plans, category and land use</p> <p>Computer modelling of risks and vulnerability</p> <p>Drone supported surveys</p> <p>Satellite and GIS to map natural ecosystems</p> <p>Model and land use changes</p> <p>Real Time warning systems using mobile phone</p> <p>Mobile apps for local communication</p> <p>Information campaign via digital media</p>
Preparedness	<p>Meteorological observation</p> <p>Spatial Mapping</p> <p>Early warning Systems</p> <p>Stockpiling</p> <p>Identifying vulnerable buildings and infrastructure</p>	<p>IoT connected and AI enabled monitoring</p> <p>Satellite based technologies to gather geospatial and Meteorological data</p> <p>Digital mapping, GIS, Open Street Maps, hazard maps</p> <p>Real Time monitoring of risks</p> <p>AI enabled cross checking of data</p> <p>Mobile based warning apps</p> <p>Digital communication systems to inform people</p> <p>AI enabled forecasting, digital accounting, and monitoring tools</p> <p>Digital inventory of stockpiles</p>

		Geospatial surveys using software such as Open Data Kits
Response	Emergency services such as search and rescue evacuation Provision of shelters and basic needs Surveillance Communication	Drones for aerial surveillance Social media monitoring Geospatial maps Apps to inform people about shelter facilities Communication infrastructure GIS mapping and aerial surveillance Broadcasting emergency messages on mobile phones Social media platforms
Recovery	Livelihood support Establishment and rehabilitation of basic services Reconstruction Planning	Cash transfers via electronic/digital tools Real-time updates on the restoration of services Digital tools to coordinate processes, construction and operations. Digital surveys, mapping and monitoring using drones

Source: Author

The spatial and non-spatial data are abstracted and synthesised to prepare a comprehensive District Hazard Risk Map.

Conclusions

By 2047, India will be world's third largest economy with a GDP of \$36 trillion. It would add about 400 million urban population to its existing 432 million. With India on a rapid trajectory of urbanisation, a major challenge is to interface the economic and ecological eco-systems. This calls for transforming in the processes of planning and development that lead to an inclusive, resilient and green path of development. India with a demographic dividend and youth power, technological advantage and a robust economy can unleash its potential. The basic approach is to adopt circular systems, factor 4 and least lifestyle technologies, and recognising the principle of 'less is more'. Simultaneously, there is also a need for urban financing, legal and governance reforms.

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