



# Insights from deployment of National Urban Data Platforms in India

National Government Support to Cities for Undertaking  
Data-driven Development



Federal Ministry  
for Housing, Urban Development  
and Building



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## Executive Summary

Smart and citizen-centred processing and sharing of data is key for liveable urban futures. Common enabling data platforms offer the opportunity to meet challenges with innovation and to unlock new potential by making them available to governments, citizens, academia, and industry. Data platforms provide valuable insights into the functioning of cities by collecting, analyzing, and disseminating data about urban areas. These platforms can help city planners, policy makers, and other stakeholders make informed decisions about issues such as transportation, housing, infrastructure, public health, and environmental sustainability.

The International Smart Cities Network (ISCN), commissioned by the German Federal Ministry for Housing, Urban Development and Building, endorses the importance of digitalisation for sustainable urban development in cities. In a cross-national dialogue, the ISCN campaigns for digital transformation to help achieve the common good. The focus is on mainstreaming digital solutions in urban processes and making it possible to share successful models and experiences. It promotes the integration of digital solutions into citizen-centric urban development processes and facilitates the exchange of Good Practices and experiences among urban development stakeholders worldwide.

Since the launch of the Network, the Indian Ministry of Housing and Urban Affairs (MoHUA) has regularly contributed and is committed to the international Smart City Dialogue. A recurring topic for India was the topic of data strategies and data usage in the sense of sustainable, citizen-centred urban development. India has launched its national strategy 'DataSmart Cities: Empowering Cities through Data' in 2019 to create a culture of data across the 100 cities in its Smart Cities Mission. The Ministry of Housing and Urban Affairs (MoHUA) in India is playing a critical role in supporting municipal data collection, management and protection.

The study "Insights from deployment of National Urban Data Platforms in India", taken by Buro Happold and commissioned by GIZ in collaboration with MoHUA, aims to understand the Indian experience with five nationally established Urban Data Platforms to provide insights into the role and responsibilities of the national government in data collection and management.

The study assesses the usability of these platforms for cities and provides recommendations for their future operation and potential growth, as well as insights into replication and leveraging potential for other cities within the ISCN network. It is starting with a policy review of existing international and national data policies, as well as research into international Good Practice to contextualise India's ecosystem of Urban Data Platforms. Subsequently, five Indian national Urban Data Platforms were assessed using Key Performance Indicators (KPIs), defined and evaluated against benchmarks identified in Good Practice. Interviews with key Indian experts complemented findings to provide a qualitative account of the use and uptake of the platforms at the national and local level.

Opportunities of platforms include increased knowledge sharing and cross-learning between cities, external collaboration with research institutions and private partners, and improved coordinated governance processes and systems. Challenges include uncertainty about the purposes of the different platforms, difficulties in coordinating them all, disparities in digitalisation for cities with less resources as well as gaps in the functionalities of the platforms and in the data availability.

Despite these challenges, Urban Data Platforms in India have the potential to lead to increased productivity in government systems and processes. The five national Urban Data Platforms developed over the years from 2019 through 2022 provide a solid basis after three years of implementation among India's 100 Smart Cities, that can be rolled out to scale across the country. Learnings need to be shared globally. India is now at a crossroad to move towards the sustainable and inclusive utilisation of data for urban development across all its cities. While the centralisation of the platforms and policies at the national scale can be effective in unifying standards and encouraging participation, decentralisation of some of the efforts, through the state level or in-between cities could also have positive effects in the future.

Further research is recommended to understand the economic potential of data and platform monetization as well as balancing between monetization and an open and accessible data culture. Consideration of integrating existing financial systems within the national government, such as the tax system or other financial levers, could also be established. Incentive mechanisms, such as establishing challenge-driven programmes and competitions with prizes, or even sanctioning (taxing), to increase participation in Urban Data Platforms practically should be explored. Investment priorities should be implemented using a multi-criteria assessment, identifying incurred preparation, development, implementation and operationalisation costs, impact, cross-benefits, unexpected consequences, timelines, enabling factors, targets and milestones. This would help with prioritising actions and thus investment.

# 1 Introduction

The International Smart Cities Network (ISCN), through its [‘Data Strategies for Public Good-oriented Urban Development’](#), emphasises the significance of digitalisation for sustainable urban development. Orienting data towards a common good, securing municipal data sovereignty and creating access to data across all sectors - private, municipal and civil society, are all of great importance to meeting this overarching goal. Creating municipal value through data, strengthening municipal services and enabling municipal business models are all opportunities to be taken forward towards a sustainable urban future.

In June 2015, the Ministry of Housing and Urban Affairs (MoHUA) in India launched the Smart Cities Mission to support cities in enhancing their operational efficiency, in optimising their governance and providing better quality of life to citizens through innovative and smart technologies and interventions.

Since then, more than 100 Smart Cities have been identified and have implemented civic infrastructure and ICT projects as per their guidelines.

In this context, India launched its national strategy [‘DataSmart Cities: Empowering Cities through Data’](#) in 2019. The strategy aims to institutionalize a culture of data across the 100 cities of India’s “Smart Cities Mission” and provides a suggested roadmap for cities to improve their readiness for intelligent use of data in addressing complex urban challenges. The DataSmart Cities strategy in India involves three key components: **people, processes, and platforms**.

**People:** The Smart Cities Mission aims to set up institutional structures at the national, state and city levels for driving and implementing data initiatives. The goal is to improve the quality of life for citizens by involving them in the planning and implementation of smart city projects. This includes capacity building for various stakeholders such as Chief Data Officers, citizen engagement and participation through various means such as town hall meetings, social media, and online portals.

**Processes:** This component refers to the establishment of clear procedures, guidelines and governance frameworks to ensure data privacy, security and quality.

**Platforms:** The mission promotes the use of digital platforms to enable better communication and coordination between government agencies and citizens. This includes the use of digital platforms for data collection and sharing, service delivery, and citizen engagement. The mission also focuses on creating a digital backbone for smart cities using technology such as cloud computing, big data analytics, and citizen engagement platforms.

Overall, the mission is an ambitious effort to create sustainable and liveable urban spaces through the use of technology, citizen engagement and efficient processes. It notes the importance of adopting appropriate data exchange platforms to lead the effective sharing and management of city data.

As a result, nationally-established Urban Data Platforms such as the ‘India Urban Data Exchange’ (IUDX), AMPLIFI, the Smart Cities Open Data Platform (SCODP), the ‘India Urban Observatory’ (IUO) and the ‘Smart Code Platform’ have been created to promote data-driven decision-making, integrate Command and Control Centres, foster collaboration and co-creation, and importantly exchange, request and store data amongst multiple stakeholders – city governments, civil society, academia, industry, businesses and citizens.

This study aims to understand the Indian experience in collecting and providing data from the national level to cities, and how data provided through the platforms mentioned above have been used locally.

The study is organised into 3 chapters:

1. **Data and Smart City Policies** reviews the policy context today within which this study is positioned and suggests key takeaways for future leverage.
2. **Urban Data Platforms** assesses the 5 short-listed nationally established Urban Data Platforms against benchmarks and Good Practice, and gives an overview on how they are used in practice by stakeholders today.
3. **Results** summarizes the study’s key findings on the usability of Urban Data Platforms for cities, with insight into the roles and responsibilities of the Indian national government in relation to those, provides opportunities, challenges and recommendations for future growth within the Indian ecosystem and further replication and transferability within the ISCN network.

The Smart Cities Mission in India is a government initiative launched in 2015 to develop 100 smart cities across the country. The goal of the mission is to create cities that have sustainable and inclusive infrastructure, provide efficient services, and improve the quality of life for citizens. This is done through the use of technology, such as smart transportation systems, smart lighting, and waste management systems, to make cities more efficient and responsive to citizens’ needs. The mission also aims to promote sustainable urban development and to create opportunities for private investment in urban infrastructure. The government is providing financial assistance to the selected smart cities for implementing various projects under the mission.

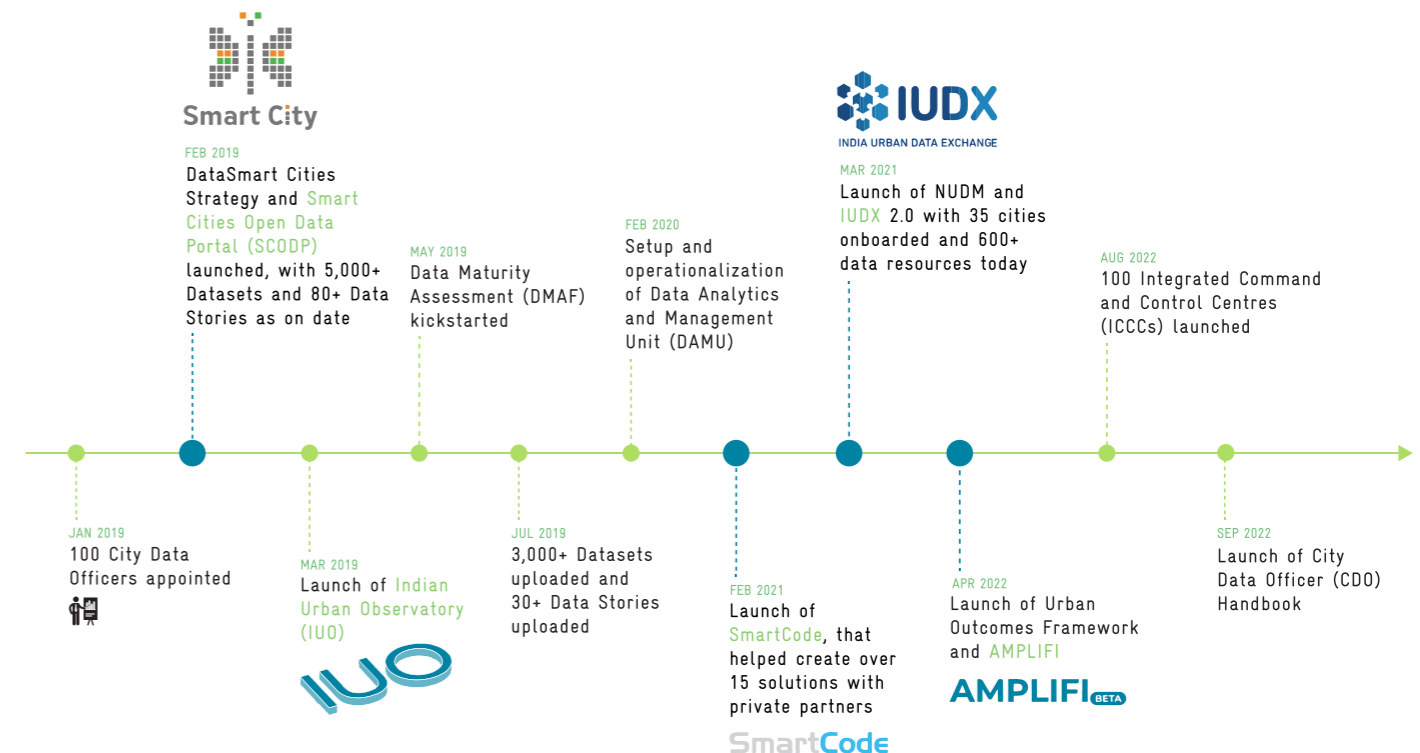


Figure 1: Timeline of key Smart Cities Mission deliverables (Buro Happold, 2023)

## 1.1 Study Mission and Objectives

In the national strategy 'DataSmart Cities: Empowering Cities Through Data', launched in 2019, the MoHUA aims to institutionalize a data culture and ecosystem across cities. This study aims to contribute to this mission by providing critical and valuable insights into the role and responsibilities of the Indian national government in relation to the collection and provision of data and information for urban development through nationally established Urban Data Platforms. Therefore, it assesses their usability in cities and municipalities. This will lead to lessons learned being shared with the ISCN and other partner countries for future transferability and scalability within their own contexts.

The study builds on previous research, including the Urban Outcomes Framework by MoHUA in India. It focuses on five Urban Data Platforms that were established by the Indian national government and provides recommendations for their future operation and potential for growth.

It aims to provide an overview of data platforms and standards for urban and municipal development in India and lessons learned will be shared with the ISCN and its partner countries.

### Benefits of the study

As seen in figure 2, not only does this study target the Indian Ministry of Housing and Urban Affairs (MoHUA) for future operation and leveraging potential of the platforms but it addresses city officials and national ministry officials in charge of the 100 Smart Cities and sustainable urban development across the ISCN. Further, the findings and recommendations are of interest to a larger group of individuals, within India and globally, involved in the development of urban and data ecosystems, who may be interested in their replication or in furthering research in this field - from research institutes, to industry and the private sector as well as the wider public and citizens. Recommendations are detailed in the later chapters of this study, which include scope for further research into monetisation of platforms and data for instance.

Lessons learned will also be shared via presentations with the ISCN.

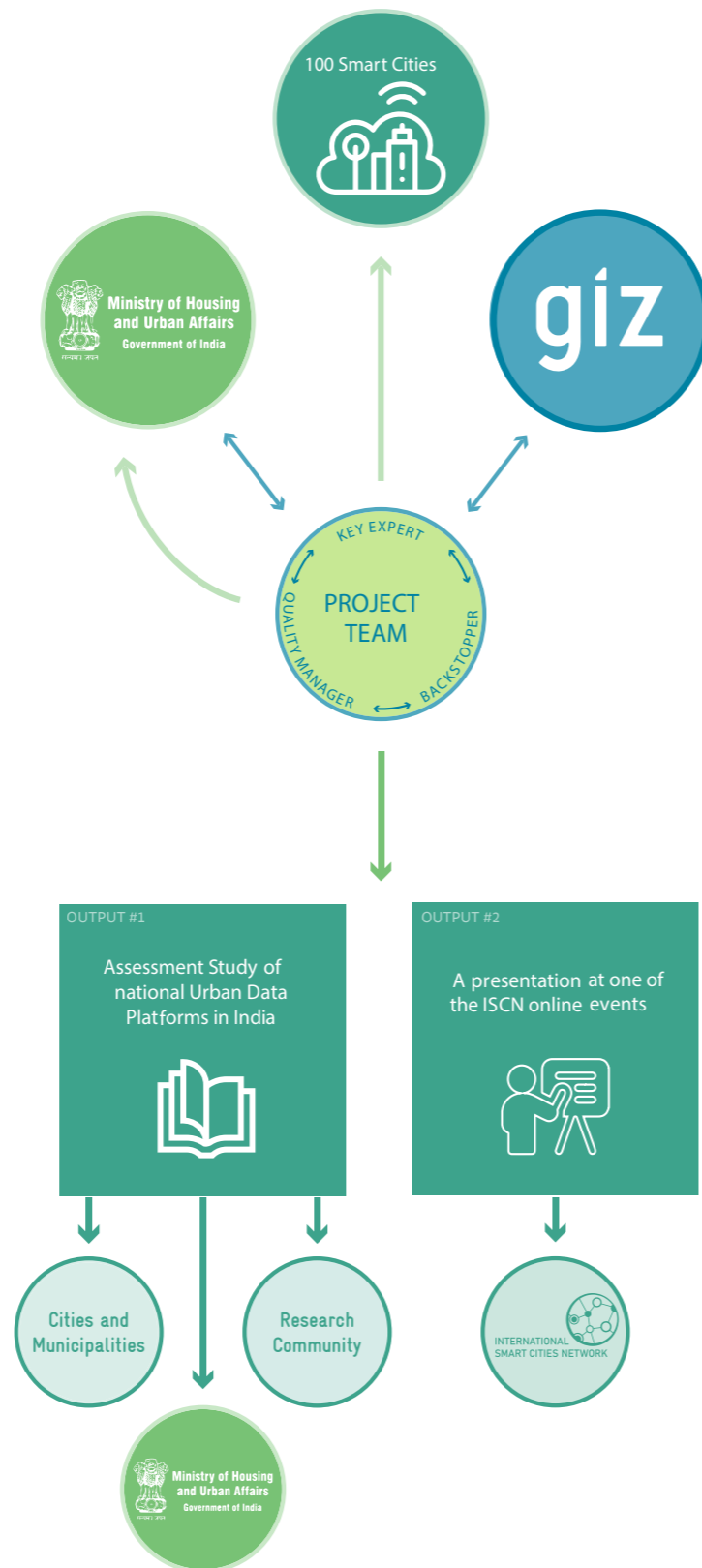


Figure 2: Study's mission and key deliverables (Buro Happold, 2023)

## 1.2 Methodology

To fulfil these objectives, the study evaluated the usability of data in cities and municipalities, through the assessment of nationally-provided Urban Data Platforms. Interviews with key experts complemented those findings and provide a qualitative account of the use and uptake of those platforms at the local level, as well as opportunities and challenges that arise from them.

Four methods constitute the overall methodological process, each of which are detailed later in this chapter:

1. Policy Review
2. Platform Assessment Framework
3. Good Practice
4. Interviews

This study followed an iterative methodological process, and not a linear one. This was to incorporate flexibility in the study and reflect that platforms are still being developed and are continuously evolving even during the time of the study.

Further, certain methods in the study were used to inform others, but were also revisited once findings started to emerge. For instance:

- **Policy Review informed the principles and categories** that led and helped to **assess the five Urban Data Platforms**.
- Further, the **Good Practice Review informed the operationalisations** in the assessment framework for the Indian Data Platforms. It helped in testing the assessment framework and its benchmarks, and establish KPIs and metrics against which the five platforms were assessed.
- **Interviews** were used to **complement the assessment** and to **understand the wider context and practicalities** of such platforms.
- However, results from interviews also helped to **revisit the metrics and KPIs** of the Assessment Framework that were previously defined by Good Practice. This meant multiple rounds of platform assessment.
- Further, interview questions were altered during the interviewing process, as new information was discovered and new points needed further clarification.

As a result, opportunities, challenges and recommendations were developed for the national government in India, with possibilities for replication and growth amongst ISCN partner countries and wider stakeholders groups, such as research institutions, the private sector and citizens.

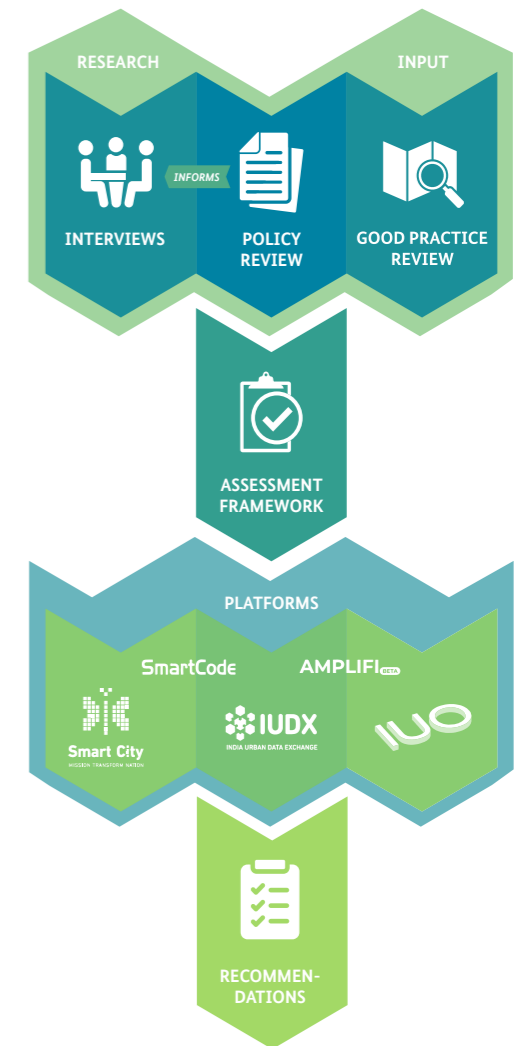


Figure 3: Study's methodology (Buro Happold, 2023)

### 1.2.1 Policy Review

A deep review of nine existing international and national policies, programmes and strategies for effective data use and management for a digital urban transition was undertaken, to represent an overarching and holistic data environment. Those were identified as the most relevant for the scope of this study. This helped in gaining a clear understanding of the overarching aspirations for a digital transition, as well as today's general data ecosystems, their drivers, stakeholders, their roles and responsibilities can help starting to identify gaps and challenges. International perspectives not only incite scaling-up and replication, but also provide valuable lessons to adjust and further define one's own digital agenda.

In more practical terms, it also helped in shortlisting five nationally established Urban Data Platforms in India for further assessment and in identifying key Persons of Interest to further interview later. The short-list was then shared with and revised by MoHUA. Further, key takeaways and actions identified in those strategy documents acted as key external drivers for the platforms' assessment, ensuring that the assessment was guided by wider systems' objectives. They ensured that KPIs and metrics used to assess the platforms are embedded within the wider ambitions for India's urban digital transformation.

### 1.2.2 Platform Assessment Framework

An Assessment Matrix with KPIs and metrics was developed to assess the five Urban Data Platforms shortlisted for the purpose of this study, in collaboration with MoHUA.

The methodology for developing the Matrix followed a 4-step process:



Figure 4: Assessment Matrix Methodology (Buro Happold, 2023)

- 1. Understanding external project drivers** - The first step to develop the Matrix is to define the context within which it is set by specifying project drivers. Those provide direction for the study's goals and inform as well as ensure that the KPIs and metrics align with the overall data ecosystem in India and internationally. The key takeaways from the policy review as well as international Good Practice acted as external project drivers for the Assessment Framework.
- 2. Identifying internal project principles** - Platforms are evaluated against principles that were derived from the project drivers (policy review and Good Practice) as well as from the overarching goals of this study. Hence, opportunities and challenges that arise from this evaluation can directly be related to this overall mission and coherent recommendations can be proposed to national government for future development. The following principles have been defined



Support the **digitisation** of urban development systems



Establish a **culture of data** across all levels of government



Ensure **transparency and accountability** of data sources



Ensure the **usability** of platforms and data



Encourage **data sharing and exchange** across cities



Promote **knowledge transfer** nationally and across countries internationally (e. g. within the ISCN)



Ensure that lessons learned, and recommendations are **transferable and scalable** across different contexts.

Figure 5: Principle icons (Buro Happold, 2023)

- 3. Identifying key categories** - Four overarching themes, or categories, emerged when identifying the project's principles and exploring the aspirations detailed in the external drivers.

These were used to group KPIs. Each theme represents all aspects of what constitutes effective use of data in urban development.



### Quality

Related to interoperability of data through its accuracy, precision, transparency, and validity. Measuring quality helps to understand the extent to which these platforms standardise and promote the usability of data and consequentially its transferability, replication and adoption – all key to fulfil the overall drivers' missions.



### Accessibility

Concerning the ease of data sharing and exchange with the ultimate goal to make data open and enable an effective and democratic digital transition.



### Usability

Linked to the adoption of appropriate platforms for effective sharing and management of city data, it directly concerns performance of the website and user-friendliness.

Figure 6: Categories (Buro Happold, 2023)

- 4. KPIs and initial targets** - Key Performance Indicators (KPIs) were lastly defined following internationally recognised standards, benchmarks and Buro Happold experience, addressing the quantity, quality and usability of data for cities and municipalities. KPIs and metrics were embedded within the wider ambitions for India's urban digital transformation.

#### Description

The description of each KPI explains what it entails in relation to the quality and usability of data, as well as the user experience on platforms.

#### Metrics

To ensure that the assessment follows a methodological approach and that all platforms are evaluated equally, the rating system and its evaluation metrics have been defined in accordance with standards and benchmarks.

A more detailed KPI Matrix is available in the Appendix, including the sources.

KPI ID	KPI	Description
<b>Quality</b>		
Q1	Accuracy	The degree to which the data matches the real world
Q2	Precision	The level of measurement and exactness
Q3	Validity	Following unified standards
Q4	Transparency / Integrity	Confidence in the data source, availability of information on data
Q5	Completeness	Comprehensiveness and wholeness of the data
Q6	Timeliness	Data should be timely enough to influence management decision making
<b>Accessibility</b>		
A1	Open data	The data follows international open data standards and hosted in a way that is common and open
A2	Registration requirements	Requirements to be able to view and download data
A3	Format diversity	Number of formats that can be downloaded and their applicability
A4	Format accessibility	Open and accessible formats, editable and easy to integrate in different workflows
A5	Guidance / documentation	Availability of documentation and guidance on using the data and platform
A6	Storability	The way the data get stored and its availability for the users
<b>Usability</b>		
U1	Performance	The stability of the platform for seamless surfing and is eligible for traffic capacity
U2	Multi-channel access	Engaging and satisfying user experience on multiple access points (e.g. PC, phone and tablet)
U3	Inclusion	Ensuring the platform is accessible to all without discrimination of physical or digital abilities
U4	Intuitivity	The website is intuitive to use, both through navigation and through search functionality
U5	Interactivity	The interaction between users and computers and other machines through a user interface
U6	Storytelling	Designers use storytelling to get insight into users, build empathy and reach them emotionally

Figure 7: Table of KPIs (Buro Happold, 2023)

Each KPI is scored against four target levels. This allows establishing benchmark references to evaluate how each platform is performing against defined standards. The four levels are as follows

- a. 'Missing' – means that it is not possible to measure the platform's performance against the KPI as the required information to evaluate is missing or not available.
- b. 'Business as Usual' - implies that the platform is scoring moderately against the standard and great input is needed to improve its performance.
- c. 'Stretch' - implies aspirations detailed in standards are achieved. When applicable the stretch level has been identified as fulfilling the basic or medium requirements of other rating systems.
- d. 'Pioneering' - implies that the platform's performance against the KPI exceeds expectations. Benchmark performance levels for the 'Pioneering' category draw from a review of international Good Practice as well as exceeding the requirements in other rating systems.

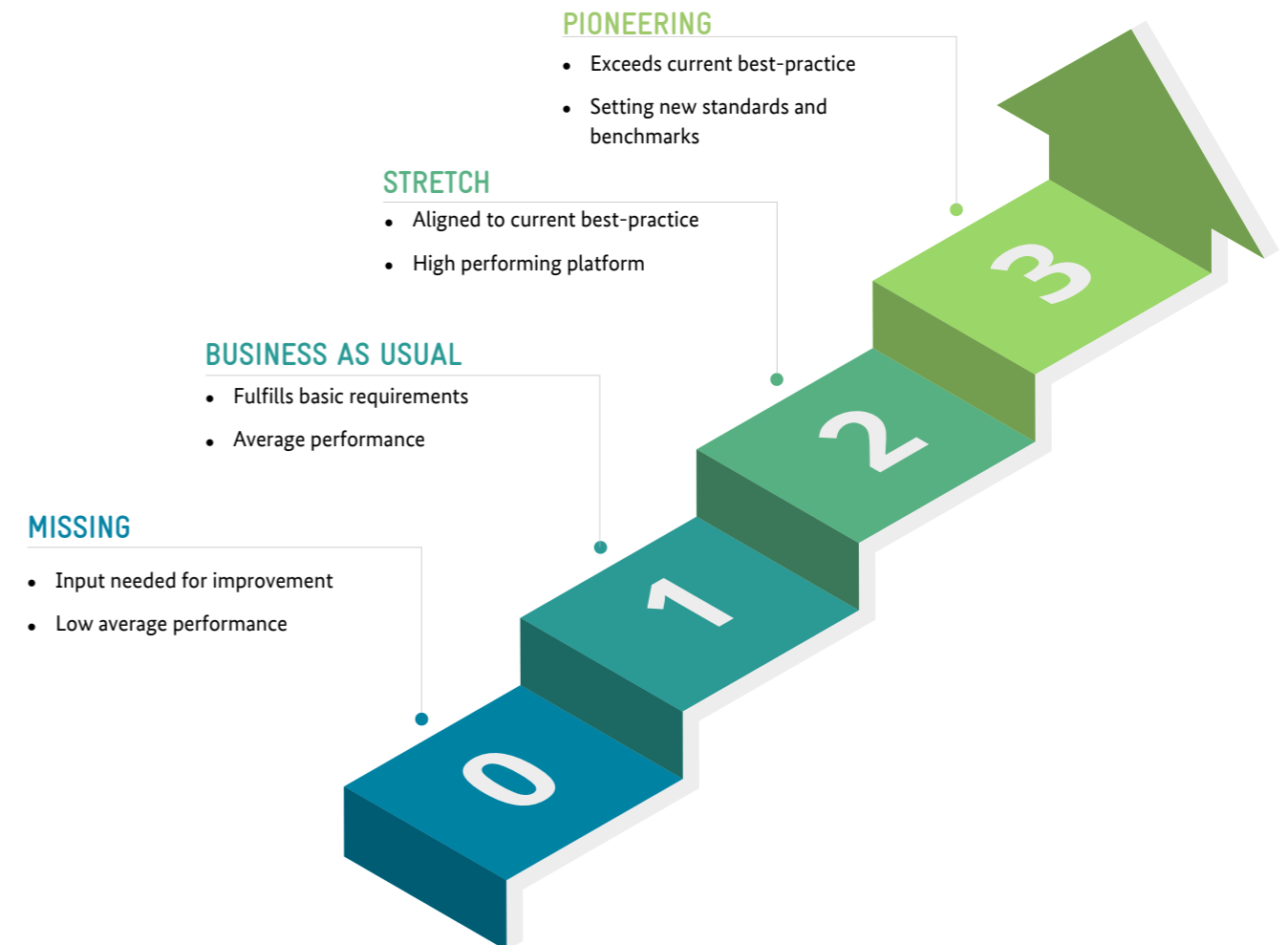


Figure 8: Target levels (Buro Happold, 2023)

All platforms were assessed by at least two experts and the average of the assessment was used for the final result captured under the Urban Data Platforms chapter.

### 1.2.3 Good Practice

Good Practice of Urban Data Platforms in the international context were investigated to contribute to the assessment of Indian Urban Data Platforms. Good Practice platforms also helped in identifying opportunities for growth and replication and inform recommendations and potential future initiatives that could be adopted by the Indian national government and beyond.

12 Good Practice Urban Data Platforms were also assessed using the developed Assessment Matrix, to ensure a coherent and logical process and validate the KPIs. They acted as comparators to the Indian Urban Data Platforms. Both data platforms established for entire countries and individual cities were assessed to ensure a complete evaluation. The selection was based on innovative features, reputation for being state-of-the-art and having interesting functionalities, which could be replicated in other contexts.

Once assessed, Good Practice Urban Data Platforms scores were used as benchmarks and informed the rating to assess the Indian Urban Data Platforms. In other words, the Assessment Matrix metrics were revisited again, to take into account questions such as:

- 'What is to be strived for?'
- 'What is pioneering and state-of-the-art in practice today?'
- 'What could be replicated in the Indian context?'

### 1.2.4 Interviews

Eight Key Expert interviews were conducted to complement the information collected during the Policy and Good Practice Review and the platform assessment.

Interviews provided insight into how processes take place in practice and the intricacies of those systems – a qualitative account of situations. They shed light onto the practicality of Urban Data Platforms and the relationships and interactions between different key stakeholders.

Through policy review, an initial list of key Persons of Interest was identified, which was then completed through consultation with the MoHUA. To gain a complete overarching understanding of the data ecosystem, both platform users and providers were targeted from three different stakeholder groups:

- City Key Experts from the local scale,
- Platform Key Experts who were involved in developing, managing and operating the different national platforms, and
- National Key Experts. Interviews helped in gaining a holistic and deep understanding of the data ecosystem at different scales and to comprehend how each stakeholder group worked with each other.

Informed by the Assessment Matrix, questions asked spanned across a number of themes, from roles, responsibilities, and governance systems, to data availability and quality, and platform navigation and accessibility. Questions also related to opportunities and challenges identified, in order to start painting a picture of potential recommendations for future platform development.

Following an iterative process, although the KPI Matrix was being developed in parallel, findings from the interviews informed the latter. Vice versa, questions were altered or added as the data ecosystem was being explored, the matrix was being developed, platforms were being assessed, or Good Practice was being reviewed.

Following thematic analysis, interview results were then categorised and clustered into themes (opportunities, challenges and suggestions) and were mapped against participants. This helped us identifying points of similarities and differences amongst those interviewed and supported the development of recommendations, their priorities and target groups.

### Limitations

It is important to note that accounts from a limited number of City Key Experts took part in the study. Therefore, results and findings may not be fully representative of the experience of Urban Data Platforms by city stakeholders. To account for this, we adapted the weighting of the city governments' perspective to balance that of the National and Platform key experts' accounts. Platform key experts and National key experts provided a detailed and comprehensive account of the use of Urban Data Platforms and process for data collection and publishing.

Another limitation concerns the platform assessment. The five Urban Data Platforms assessed are always under development and enhancements are made continuously. Our evaluation is only a snapshot of time. We noticed that even during the course of the study, changes and maintenance work were undergoing. Regular assessments of the platforms on fixed intervals can provide the best results. Further, we assessed the publicly accessible parts of the platforms as well as the parts where access can be granted to individual users. Hence, our assessment does not include parts that have restricted access to specific entities, organizations or data providers. The interviews helped mitigating this limitation.





## 2 Data and Smart City Policies

The aim of reviewing existing policies is to gain an overall understanding of the aspirations as well as the established policies and standards for Data and Platform ecosystems.

Both international and national policies were reviewed, to represent an overarching and holistic picture of data policy. International perspectives not only incite scaling-up and replication, but also help in translating stated ambitions into realities and offer ideas to adapt original strategies to new and unforeseen circumstances. This study seeks to shed more light on some of those unexpected dynamics. Key lessons and takeaways, relevant to the objectives of this study, targeted at national and/or city governments, were conveyed for each document.

Each policy assessment is structured as follows:

1. **General description** with key objectives relevant to this study's objectives
2. Existing **challenges** highlighted by existing policies, which this study when assessing Indian platforms should acknowledge when proposing recommendations for the Indian context
3. **Key takeaways and actions** to adopt within and adapt in this study and further afield

Data Strategies for a Common Good-oriented Urban Development, The Sustainable Urban Development Goals, and The People Centred Smart Cities Flagship Programme are reviewed as international cases; while others are reviewed as national missions, strategies, frameworks, and policies. Those are all related, however, they have different purposes. Policies set the rules, frameworks provide the structure, strategies outline the plan of action and mission guides the overall purpose of the organization. The following documents have been reviewed as national cases:

### 2.1 Global Policies



The Sustainable Development Goals (SDGs) | UN  
(United Nations, 2015)

#### General description

- The Sustainable Development Goals (SDGs) is a set of 17 goals adopted by the United Nations General Assembly in 2015 as part of the 2030 Agenda for Sustainable Development. The SDGs are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.
- The SDGs advocate for smart cities as representative of the use of technology to support cities' sustainable development.
- Economic growth, social cohesion, and environmental protection are intrinsically linked to the "smart" dimension of urban development, implying the use of technology in almost all urban functions.
- Such an approach to urban development leads to the accomplishment of Sustainable Development Goals; especially the one concerning the promotion of safe, resilient, inclusive, and sustainable cities (SDG 11).

#### Challenges identified, to both city and national governments

- Lack of resources and funding: Significant investments are needed in infrastructure and services, this includes in data architecture
- Lack of data and monitoring systems: many countries lack the systems needed to track progress and make informed decisions.
- Limited public awareness and engagement: there is limited public awareness and engagement from all stakeholders, including citizens, on urban processes and solutions.

#### Key takeaways and actions, to both city and national governments:

- Take comprehensive and integrated approach when addressing complex challenges and developing solutions
- Cooperation and coordination among all actors, including governments, the private sector, civil society, and individuals, as well as strong political will and commitment
- Create targets and indicators when measuring progress and tracking the implementation of the goals, projects and solutions

## Data Strategies for a Common Good-oriented Urban Development | ISCN (International Smart Cities Network (ISCN), 2022)



### General description of document

The “Data Strategies for a Common Good-oriented Urban Development” is a strategy developed by ISCN to help cities create a data-driven culture to support urban development and planning in a way that prioritizes common good and sustainability.

Its objectives are:

- To highlight the importance of data-driven decision making in urban development and the need for cities to have access to high-quality data in order to make informed decisions.
- To provide guidance on data governance and data management like clear policies and procedures for collecting, storing, and sharing data.
- To encourage active engagement with stakeholders to ensure transparency, accountability and responsiveness of data collection and use
- To provide recommendations for investment (infrastructure and capacity-building)
- To promote collaboration between cities and other organizations to share data, knowledge, and Good Practices

### Challenges

For city governments:

- Lack of access to high-quality data: to support data-driven decision making in cities – ensuring data quality is a challenging task since skills and resources are scarce and manual “data-plumbing” is a luxury most cities cannot afford.
- Data governance and management: Cities and municipalities can sometimes lack foundational policies for sound deployment of technologies and data-based interventions. Cities lack the capacity and stakeholder coordination to establish data governance frameworks needed to ensure transparency, accountability and responsiveness in data,
- Engaging with citizens and stakeholders: Communicating technical details and complex technological processes of Urban Data Platforms to citizens and municipal authorities can be challenging. Complicated narratives might be received with resistance and even fear.

For national governments:

- Collaboration and coordination: getting all stakeholders involved, with differing agendas, priorities and understandings is complex

For both:

- Privacy and security concerns: due to varying goals and regulations across levels of government, as well as the absence of a clear regulatory framework for privacy and data-protection
- Limited capacity and resources: Building the digital capacity of city staff (training and support) to use data effectively can be a demanding and expensive task for cities

### Key takeaways and actions

**DIRECTED AT CITY GOVERNMENTS, with support needed from national government to standardise process across the country:**

- Establish data governance and ensure data quality; Refer to common reference architectures to achieve interoperability; Make use of high-quality sensor data; Harness a use-case driven approach to data. Engage in storytelling to show how data helps cities “do better”, present use cases and good practice, engage and motivate; Don’t spend time and money to collect and improve datasets if you do not know what to do with them; Make open data useful – publishing a core set of data with good Application Programming Interfaces (APIs) might be a better approach than publishing high quantities of non-functioning data; Integrate data regulations and goals between the local and the state/provincial level
- Gain access to third-party data: Explore how a city can provide a benefit and incentivise to data generating companies; Create “Data partnership Agreements” between cities, companies, and research institutions to ensure data exchange; Award contracts under open source data provision requirements.
- Develop technological competencies internally: identify skill-gaps and develop tailored training programs about digital tools for staff with support from IT departments

**DIRECTED AT CITY GOVERNMENTS PRIMARILY:**

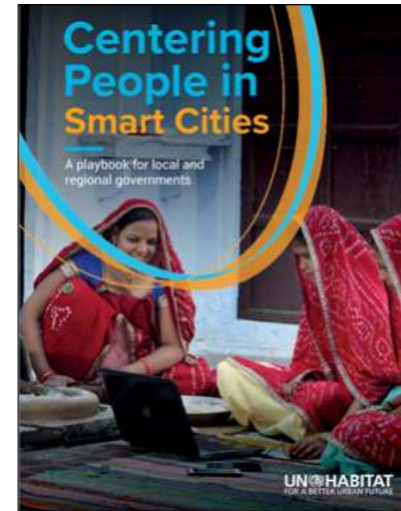
- Achieve a common understanding of data: Draft user-friendly departmental guides to ensure staff understands the data approach; Overcome the deficit of citizens’ digital-trust by providing accessible and understandable information on what governments do with data and how they ensure its protection; Overcome internal resistance to open data by portraying its outcomes and advantages (e.g. saving time, efficiency, insights).

**DIRECTED AT BOTH:**

- Invest in digital infrastructure: Identify immediate priority investments and gradually implement technologies, by developing partnerships with industry to support established information and communication infrastructure plans
- Collaborate with the private sector and smaller start-ups to orchestrate innovation, creativity and bring new and innovative players on board.

## The People Centred Smart Cities Flagship Programme | UN Habitat

(UN Habitat, 2020)



### General description

The People Centred Smart Cities Flagship Programme is designed by UN Habitat to support cities in creating smart, inclusive, and sustainable urban environments that prioritize the needs of citizens and communities.

The three main objectives are:

- Policy transformation through mainstreaming of people-centered, sustainable and inclusive digital transition as a critical policy topic in high level political forums and global dialogues on smart cities
- Financing digital urban innovation with a specific focus on developing countries, small and medium size cities and grassroots urban communities
- Digital empowerment and capacity building of governments at all levels to adopt a rights-preserving approach to digital technologies

### Key takeaways and actions

#### DIRECTED AT BOTH:

- Provide digital public goods that are open, transparent, accessible and interoperable
- Make access to technology equitable by building a foundation of universal access to affordable internet, digital skills and digital devices
- Establish multi-stakeholder governance process and technical working groups
- Invest in frontier technology and urban innovation initiatives that aim to achieve the SDGs at the local level
- UN as guidance, such as their smart cities principles, ethical digital standards, Good Practice on the implications of frontier technologies, governance frameworks on urban data, including data sovereignty and privacy-enhancing technologies, toolkits on smart city strategies, technology procurement and management guidelines, development of performance metrics, KPIs and operational benchmarks, etc.
- Adopt the UN's technical assistance and advice on the adoption and implementation of smart city strategies, policies and solutions

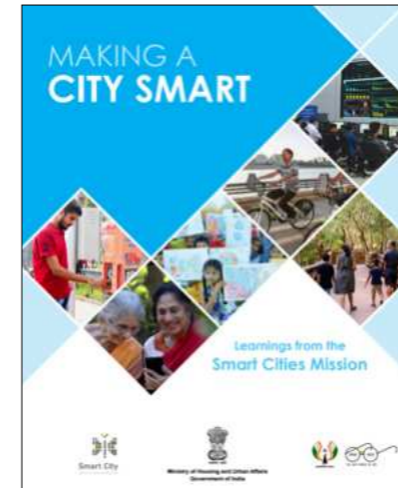
#### DIRECTED AT CITY GOVERNMENTS PRIMARILY:

- Use the UN's piloted and tested solutions, technology, and innovations especially those concerning bottom-up participatory approaches and the inclusion of marginalized groups in smart-city solutions

#### DIRECTED AT NATIONAL GOVERNMENT PRIMARILY:

- Responsibly manage data and digital infrastructure by creating a framework that sets standards and responsibilities for effectiveness, accountability and inclusivity
- Safeguard public trust by putting cybersecurity measures in place that protect data and infrastructure
- Engage urban digital technology platforms recommended by the UN such as relevant ITU study groups, the G20 Global Smart Cities Alliance, Open and Agile Smart Cities and the Cities for Digital Rights Coalition and United for Smart Sustainable Cities
- Engage with relevant Human Rights Forums
- Invest to catalyze innovative smart city visions that are inclusive, sustainable and resilient
- Take part in the challenge-driven innovation programme that uses a variety of open innovation tools, including challenge prizes, to match cities' pressing needs with innovators and technology providers, including startups, community based organizations and SMEs

## 2.2 National Policies, Strategies and Reference Guides in India



## Making a City Smart: Learnings from the Smart Cities Mission | MoHUA

(Ministry of Housing and Urban Affairs, Government of India, 2021)

### General description

- The mission is a government initiative launched by the Ministry of Housing and Urban Affairs (MoHUA) in India with the goal of creating 100 smart cities in India by modernizing the existing mid-sized cities and making them more liveable and sustainable.
- The document sets out a comprehensive strategy for creating smart and sustainable cities in India.
- Key relevant objectives focus on:
  - the improvement of the quality of life for residents by providing them with access to better infrastructure and services, and amenities,
  - make cities more responsive to citizens' needs,
  - promote inclusive and equitable urban development,
  - encourage private sector investment and promote public-private partnerships,
  - empower local communities to take an active role in shaping development and ensure their voices are heard in the planning and decision-making process and
  - foster innovation and entrepreneurship.

### Key takeaways and actions

#### DIRECTED AT NATIONAL GOVERNMENT PRIMARILY:

- Implement technology governance frameworks and Open Data Policies.
- Adopt cyber security and privacy policies and regulatory domains.

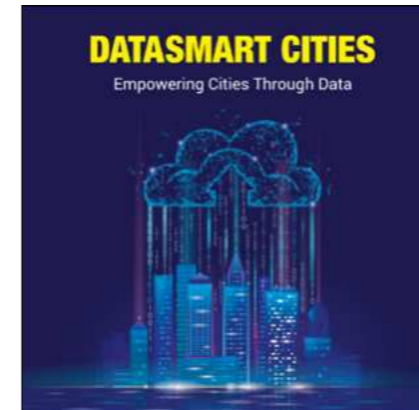
#### DIRECTED AT CITY GOVERNMENTS, with support needed from national government to standardise process across the country:

- Establish well trained city teams, and collaborations with industry and academia

#### DIRECTED AT BOTH:

- Data should be stored, governed, and managed as per IT Act and applicable laws of the land. Public data cannot be owned by third party or vendor at any point in time
- Data is key to informed decision-making. It can be used to prioritise as well as validate investments
- Include Integrated Command and Control Centers (ICCC) to help monitor data and help connect it with other convergent services

## DataSmart Cities: Empowering Cities Through Data | MoHUA (Ministry of Housing and Urban Affairs, 2019)



### General description

- DataSmart Cities: Empowering Cities Through Data is a government initiative launched by the Ministry of Housing and Urban Affairs (MoHUA) in India to empower cities through the use of data by providing them with the tools and resources they need to collect, analyse, and use data effectively.
- The main objective of this initiative is to enable cities to make data-driven decisions and to use data to improve the delivery of public services and to increase citizen participation in decision-making. The initiative focuses on providing cities with access to data, analytics, and visualisation tools, and on helping them to develop data governance frameworks and policies.

### Challenges

For city governments:

- Digitalisation of cities: Much of the data is still collected and reviewed manually, leading to difficulties in inciting cities to adopt digital tools.
- Limited budgets and citizens engagement: When city administrations are making the inevitable trade-offs involved in spending limited budgets, it is challenging for them to truly represent the views of all citizens.
- Implementation in silo and limits in cooperation: Smart city projects are largely independent, created in vertical silos, with no standardization of software components or their interfaces or the underlying data models. Data created is usually only available within the application and cannot be leveraged more broadly. This limits the ability to gain broader insights, for use between various stakeholders within the city and across different cities.
- Lack of a 'Culture of data': Despite availability of useful data, not much of it is used to draw insights and create actionable intelligence for city governance. Collaboration and the economic potential is missing. Data governance is also a challenge. Complex issues are solved through a fragmented, over-simplified and piecemeal approach.

For both city and national governments:

- Lack of a City Data Policy: lack of clarity on data policy, especially for data that are in the "grey zone" where clear policies are required that balance privacy, ownership and safety considerations. Policy is needed to define key stakeholders, and collaboration between various governmental/non-governmental entities on sharing and access of data. It should lay out the roadmap with milestones.
- Lack of alliance and coordination amongst all data collecting entities – government, businesses, communities, institutes, universities, NGOs that today work in silos.
- Lack of appropriate Data platforms: existing technical incompatibility which prevents the effective sharing and exploitation of data across a city. Common programming interfaces, data representation formats and data models are necessary to achieve data interoperability.
- Lack of awareness of economic potential: important to understand that "data" is not the goal, but the means to create solutions. Cities should 'broker' the right engagement amongst stakeholders.

### Key takeaways and actions

**DIRECTED AT CITY GOVERNMENTS, with support needed from national government to standardise process across the country:**

- Establish open data and government-owned proprietary technologies that provide data capture and analysis capabilities, bearing in mind data usage goals (data indexing, depth of analytics required), storage and indexing needs, technical expertise available and financial appetite. Ease of data collection should be the top priority. Data should be secure and accessible in accordance with user rights both in raw and analysed form. The analysed data should be accessible on multiple devices and other desired channels.
- Invest in capacity building and training on how to collect data and use analytics tools.
- Assess data requirements of various stakeholders in smart city ecosystems, including external stakeholders. City Data Officer must engage at Operational, Tactical and Strategic level. Data needs and frequency of consumption needs to be outlined.
- Define Use Cases for decision-making or policy.
- Data must be published following the standards below:
  - Open by default and in formats specified under NDSAP and accessed without the need for a software license (i.e. CSV, XLS, ODS, XML, RDF, KML, GML, RSS/ATOM).
  - Provide data and information using common data taxonomy/structure.
  - Data catalogue with title, description, keywords, group name, sector and sub-sector, asset jurisdiction.
  - Machine readable
  - Maintained, up-to-date and archived with archiving information
  - Ownership – all datasets will remain property of the owner
- Data Analysis using mathematics, statistics, predictive modelling and machine-learning techniques to uncover insight from the relevant data.

- Create data-sharing agreements with other cities, organizations, and the private sector to access new data sources and share information.

**DIRECTED AT NATIONAL GOVERNMENT PRIMARILY:**

- Establish Open Source along with a roadmap for evolution to a mature data marketplace.
- Establish open innovation and hold Hackathons/Innovation competitions. Better techniques or useful data could be shared with participants to drive new insights.
- Invest in data analytics and visualisation tools that help cities make sense of large amounts of data and communicate their findings to stakeholders.

**DIRECTED AT BOTH:**

- Integrate data sharing models like APIs, data pooling from different sources, intelligence products to create predictive models and machine learning techniques, prizes and challenges, research partnerships and trusted intermediaries.
- Build data alliances at various other government and private levels.
- Stimulate data demand by outlining Key Performance Indicators and scorecard to assess the performance of its resources.
- Open government with citizen engagement/complaint apps, for transparency and accountability, responsive administration with metrics and target to track government performance, open innovation and co-creation of policies and decisions to the general public with smarter and efficient operations like people's panels and participatory budgeting through platforms and apps.
- Support the creation of a thriving data marketplace as a sustainable model for smart city solutions for businesses.

## National Urban Innovation Stack (NUIS) | NIUA

(National Institute of Urban Affairs, 2019)



### General description

The National Urban Innovation Stack (NUIS) is a framework, developed by the National Institute of Urban Affairs (NIUA), providing a collection of cloud-based services. Each service efficiently provides a single capability across multiple urban services, accessible through using simple, open APIs compatible with global standards. In addition, it provides a set of open standards and specifications.

### Challenges

For city governments:

- Lack of accurate, up-to-date data and information, which makes it difficult for policymakers to make informed decisions.
- Limited citizen engagement which can lead to a lack of buy-in for development projects and a lack of accountability for local officials.
- Limited capacity of local bodies and urban local bodies (ULBs) and lack of technical expertise among staff, lack of institutional and financial autonomy, and limited scope of revenue generation.

For both city and national governments:

- Lack of coordinated planning.
- Poor urban governance capacities to undergo traditional training programmes, significant capacity issues, with low levels of staffing, key urban management and governance skill sets, and appropriate training resources or delivery methods, leading to being overwhelmed by the demands of citizens, industry, state.
- Absence of trust, accountability and participation, because of a general lack of digitalised data, unwieldy for analysis and lack of evidence-based decision-making.
- Limited harnessing of innovation with business-as-usual approaches, constrained functionalities and outmoded systems, lack of incubation of innovative ideas.
- Low level of rigour in planning, design, execution and monitoring with siloed, inaccessible and outdated data.

### Key takeaways and actions

#### DIRECTED AT NATIONAL GOVERNMENT PRIMARILY:

- Create standards, specifications, certifications, systems and tools for urban stakeholders to share data with authenticated, secure and consented data access between different organizations and digital systems.
- Ensure interoperability through Open APIs and Open Standards.
- Enable privacy and security by design and ensure appropriate security controls, using standards and certification for encryption and integrity.
- Create federated architecture, extensibility and allow multi-channel access ensuring an engaging user experience for rapid adoption and ease of operation by end user.

#### DIRECTED AT BOTH:

- Eliminate information asymmetries by sharing relevant information including data, knowledge, urban development plans, strengths, capabilities and resource information. Provide relevant networking and meeting tools as well as data and information catalogues.
- Increase transparency and accountability through verified registry and transaction trails.
- Overcome complicated procurement processes and identify fit for purpose innovations and connect with start-ups.
- Link academia and urban policy and practice by establishing partnerships with leading national and international academic institutions. New evidence and innovations can enable new market opportunities.
- Anchor the capacity building efforts to ensure that stakeholders have the knowledge they possess to digitize data and make it available in a streamlined manner. Enable the delivery of training programs and certification courses.

## Urban Outcomes Framework | MoHUA

(Ministry of Housing and Urban Affairs, 2022)



### General description

The Urban Outcomes Framework (UOF) is a framework developed by the Ministry of Housing and Urban Affairs (MoHUA) that aims to measure and evaluate the performance of urban areas by assessing the outcomes of urban policies and programs with a set of metrics and indicators to help cities and other stakeholders understand the impact of their actions.

### Challenges

For city governments:

- Data availability and quality
- Measuring progress towards achieving urban outcomes, particularly when outcomes are complex and multi-dimensional

For national government:

- Flexibility to changing context and adaptability: the future is uncertain, ambitions can change, and so do responding frameworks and plans. Therefore, strategies must reflect this. It is difficult to manage this unpredictability in a solution-driven context.

For both:

- Stakeholder engagement, including residents, businesses, and government officials
- Continuous monitoring and evaluation

### Key takeaways and actions

**DIRECTED AT CITY GOVERNMENTS, with support needed from national government to standardise process across the country:**

- Provide data across a wide range of sectors, such as Demography, Economy, Education, Energy, Finance, Environment, Governance & ICT, Health, Housing, Mobility, Planning, Safety and Security, Solid Waste Management, Water and sanitation
- Universalise access to information and data from professionals, researchers and academics to citizens and enable a participatory micro-governance at the municipal level.
- Use the Urban Outcomes Framework 2022 as a source for indices, research reports, and surveys. Open access to a large set of sources will provide a one-stop platform across different sectors and cities.
- Update data on a regular basis.
- Develop a transparent, clear, simple and comprehensive data-base.

#### DIRECTED AT BOTH:

- Provide access to reliable data for evidence-based policy-making, to facilitate in-depth research.
- Democratise data by making it accessible to all urban stakeholders in government, academic institutions, citizenry and industry.
- Enable everybody within a society to comfortably access and use data and empower citizens to voice their concerns and make informed decisions.
- Educate, raise awareness and sensitise people on how to use digital platforms.

## Data Maturity Assessment Framework (DMAF) | MoHUA (Ministry of Housing and Urban Affairs, 2019)



### General description

The Ministry of Housing and Urban Affairs (MoHUA) in India has developed a Data Maturity Assessment Framework (DMAF) to assess the readiness of cities' data maturity in Smart Cities based on the DSC Strategy. It seeks to encourage cities to plan and incorporate actions on data initiatives. This is to help cities to build a solid foundation which will serve as the base for an effective data ecosystem. The DMAF is divided into two cycles, with Cycle 1 focusing on the planning and design phase of the projects and Cycle 2 focusing on the implementation, institutionalisation and operationalisation phase. The DMAF assesses various aspects of the cities' and states' performance, including governance, financing, and service delivery, and provides recommendations for improvement.

### Challenges

For city governments:

- Limited capacity to implement data initiatives, which could impact their performance in the DMAF assessment.
- Variations in the implementation of data initiatives between cities (timeframes etc.), which make evaluating and comparing their performance difficult.
- Limited financial resources for implementation of data initiatives, lack of staffing.

For both national and city governments:

- Data availability and quality for assessment and evaluation of the cities' and states' performance.
- Political and bureaucratic inconsistencies – elected officials have different priorities and visions and digitalisation may not be one of them, therefore the approval process may be delayed.
- Resistance to implementing changes as per the DMAF recommendations.

### Key takeaways and actions

**DIRECTED AT CITY GOVERNMENTS, with support needed from national government to standardise process across the country:**

- Establish a City Active SCODP, with electronic collection of data, machine readable datasets, updating of datasets and high levels of compliance on actualization.
- Digitise citizen-centric services.
- Develop applications for citizens to engage with urban decision-making and create data-related use cases.
- Provide up-to-date data and spatial/geo-tagged data and status reports.
- Integrate data feeds with the Command and Control Centre.
- Provide an Online Management Information System.
- Anonymise datasets and feeds.

**DIRECTED AT NATIONAL GOVERNMENT PRIMARILY:**

- Develop a data policy with clear indications of data classification, categorisation, approval framework, archives, security frameworks,

guidelines for data collection, processing, cleaning, quality assessment and publishing.

- Appoint more City Data Officers, coordinators and government departments for delivering urban services.
- Provide robust backup and retention policies and continuity plans to deal with data loss and/or systems failure.
- Undertake trainings and workshops to build capacity.
- Form a Smart City Data Alliance.
- Organise hackathon events and co-create data challenges for Academia.

**DIRECTED AT BOTH:**

- Ensure robustness of ICT infrastructure including the provision of digital platforms, sensors, IoT devices, data exchanges, big data and artificial intelligence .
- Implement data analytics to generate visualisations and insights from available data sets/feeds.



## National Data Sharing and Accessibility Policy | DST (Ministry of Science and Technology, Department of Science and Technology, 2012)

### General description

The National Data Sharing and Accessibility Policy is a policy framework developed by the Department of Science and Technology (DST) Aayog, in partnership with the Ministry of Electronics and Information Technology (MeitY) and the Ministry of Statistics and Programme Implementation (MoSPI). It indicates data sharing and accessibility legislation.

### Challenges

For city governments:

- Data quality and standardization leading to inconsistencies and errors
- Data privacy and security concerns
- Limited awareness and understanding of the policy
- Limited resources to implement the policy

### Key takeaways and actions

**DIRECTED AT CITY GOVERNMENTS, with support from national government to standardise process across the country:**

- Create and maintain a data catalogue that lists all the datasets that are available for sharing.
- Target high completeness, timeliness and primacy in data development.
- Data holding organizations should be re-classifying their data and prepare a negative list of sensitive data, keeping in view the broad guidelines delineated in the RTI Act 2005 and taking into account the use of commonly owned standards.
- Convert analogue data into digital domain, linked to the ease of physical and electronic access and machine readability.

**DIRECTED AT NATIONAL GOVERNMENT PRIMARILY:**

- Adopt data standards for the collection, management, and sharing of data.
- Implement measures to protect the privacy and security of sensitive data.

**DIRECTED AT BOTH:**

- Resource Allocation: Allocate the necessary resources to effectively implement the policy.
- Consider licensing of data and usage costs.



## 2.3 Conclusions

Regardless of their scope, the documents reviewed above present similarities in terms of challenges and key takeaways for future growth.

Challenges for cities focus primarily on:

- lack of resources and funding, both for establishing digital infrastructure and capacity-building delivery,
- lack of high-quality data and standardisation systems, including formatting, security and privacy, which then leads to poor evidence-based analytics, to thus a lack of trust and feelings of resistance to digitalisation, and consequently a lack of participation,
- difficulties to move towards a digital transition and innovation-based urban transformation due to lack of digital competencies and data still being mostly documented manually via business-as-usual approaches and outdated systems

Related to those points, national governments globally lack clear policies and regulations regarding data standardisation, especially around security and privacy, to support cities. They also struggle in establishing incentivisation mechanisms to encourage cities' participation in digital transformation, or on the other hand, sanctioning tools to hold them accountable. Finally, collaboration and coordination of a diversity of stakeholders with differing agendas, priorities and understandings is a challenge.

It was noted that, to some extent, both Cities and National Governments are restricted in their digital capacities because of a general limited awareness of the benefits to use digital tools for urban development. Further, they lack coordination between each other, executing urban development in silo, partly due to political and bureaucratic inconsistencies. Finally, there is a general lack of awareness of economic and monetisation opportunities and potential. This is closely related to limited external engagement, not only with the private sector, but other third party entities, such as academic and research institutions, which restrict their innovative possibilities.

In response, a number of takeaways are identified for future development of the digital ecosystem in India. Regarding cities, it was suggested that they should develop higher quality and robust data infrastructure and collecting tools, data sharing models and common reference architecture, like APIs, to achieve interoperability. Related to this, they should strive to automate data collection and processing as much as possible, for example through ensuring machine-readable datasets, to guarantee that it is updated regularly.

To support this, national governments should focus investment using a needs-based approach, identifying immediate priorities based on identified challenges, such as in capacity building, training and skills development. Further clear regulatory and data standardisation policies and certifications must be defined and implemented regarding data security and ownership, licensing, formatting, access, ap-

proval framework, archiving, data cleaning, quality assessment and publishing, backup-, retention- and continuity plans. A way to incentivise cities in participating and encourage collaboration between different sectors is by establishing challenge-driven programmes and competitions with prizes. Finally, to explore pathways towards data monetisation, data government should create a clear roadmap towards using platforms as a data marketplace, in other words using platforms as an online transactional location or store that facilitates the buying and selling of data.

Opportunities below are considered implementable at both levels in India and essential to incentivize cities to engage with data driven urban development:

- Enabling data monetisation
  - Establish data partnership agreements between different organisation to ensure data exchange and explore opportunities and mechanisms for monetisation, especially with the start-up communities
  - Consider licensing and usage costs of data, as well as membership of platforms, as a pathway towards monetisation
- Capacity-building
  - Develop tailored skill-building programmes, with IT departments, through hackathons or other interactive means
  - Create accessible user-guides, tailored to the target audience, showcasing how data is later used, how it is secure, and benefits of a digital transition (saving time and resources for example) to overcome resistance to digitalisation and start a process of behavioural change
  - Develop use cases and Good Practice that could be replicated
- Partnership and collaboration
  - Invest in data analytics and visualisation tools, in collaboration with third parties such as research and academic institutions
  - Establish a coordinated digital system, integrating national and local tools, ensuring that they 'speak' to each other through common data structures and architecture
- Accountability and monitoring
  - Establish clear monitoring, evaluation and tracking tools with KPIs and scorecards to measure performance and build accountability
  - Rewarding stakeholders who engage and provide best practice through public acknowledgement and funding

All in all, understanding challenges and priorities for growth helped in informing the assessment of the five Indian Urban Data Platforms. It is fundamental to understand the wider ambitions towards a digital transition when evaluating the performance of platforms today. We identified the following points as overarching goals and principles throughout the policies that form a basis for developing KPIs for Urban Data Platforms:

- Support the **digitisation** of urban development systems
- Establish a **culture of data** across all levels of government
- Ensure the **usability** of platforms and data
- Ensure **transparency and accountability** of data sources
- Encourage **data sharing and exchange** across cities
- Promote **knowledge transfer** nationally and across countries internationally (for example through the ISCN)
- Ensure that lessons learned and recommendations are **transferable and scalable** across different contexts.

### 3 Urban Data Platforms

Urban Data Platforms exist across the globe and vary in scale, function, target group and quality. We define Urban Data Platforms as software infrastructure that helps stakeholders collect, manage, access, process, analyze (Soe, Ruohomäki and Patzig, 2022) and/or visualize datasets related to the urban environment (Eicker et al., 2020).

#### 3.1 Global Good Practice

To identify opportunities for growth and replication and inform future initiatives, global Good Practice and key takeaways must be under-

stood. 12 examples of such Good Practice were identified to be used as ‘comparators’ to the India data platforms. Those were chosen following a review of policy documents (previous chapter) which considered those as state-of-the-art use cases for future replicability, as well as desktop research into best examples of data platforms worldwide that have proven to be successful within their respective contexts.

This section presents the key takeaways and lessons learned for replication of a variety of Urban Data Platforms Good Practice, including:



Figure 9: Map of good practices (Buro Happold, 2023)

7 at the city/regional level:

- New York,
- Berlin,
- Helsinki Region,
- Dubai,
- Barcelona and
- Amsterdam

5 at the national level:

- Germany,
- the United States,
- Singapore,
- The United Kingdom,
- France

The 12 platforms were assessed through a scoring matrix, using the same assessment system as the one used to assess the Indian Urban Data Platforms. They provide a wide range of data on the local and national level, including data on the economy, demographics, health, transportation, and environment. The data can be useful for researchers, businesses, and policymakers. However, city-level platforms tend to offer data that is more relevant to the daily lives of local residents, while national-level platforms offer data that is more comprehensive and relevant for national-level research and decision-making.

The differences between national and city platforms can be listed as follows:

- **Scope/Data focus:** National platforms have a broader scope and provide data on a national level, such as economic indicators, demographic data, and energy data, whereas city-level platforms provide more localized data specific to the city.
- **User base:** National platforms have a wider user base, as the data they provide is relevant to a larger number of people and organizations, while city-level platforms have a more targeted user base, as the data they provide is more localized.
- **Innovation:** Both national and city-level platforms have the potential to drive innovation by making data available for use in new and creative ways. However, city-level platforms have a greater potential for innovation in areas such as urban planning and smart city development, as the data they provide is more relevant to these fields.

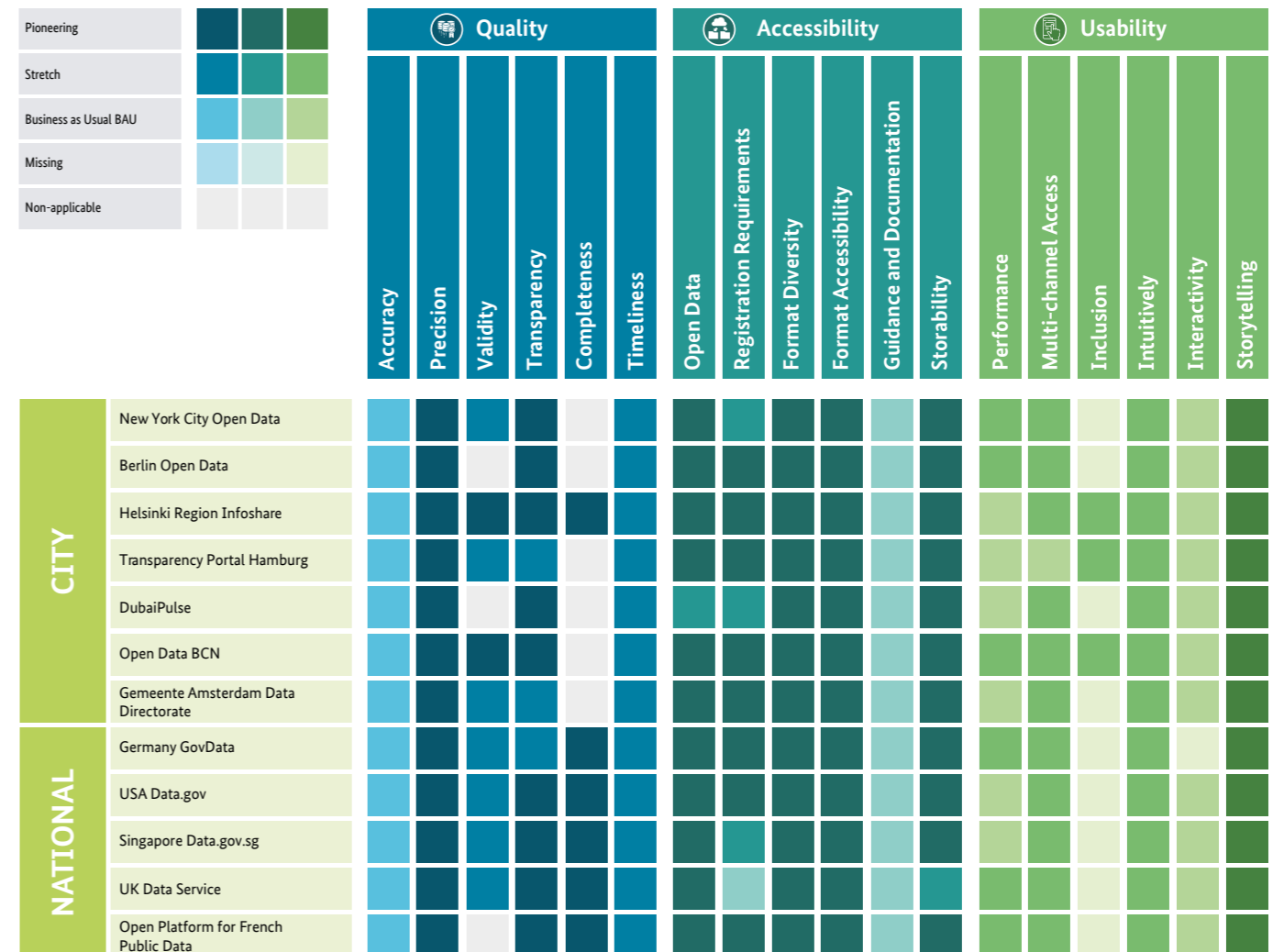


Figure 10: Good Practice assessment overview (Buro Happold, 2023)

In conclusion, both city and national platforms have their own strengths and opportunities for promoting transparency, collaboration, and innovation. The key takeaways and lessons learned from these portals will depend on the scope and focus of the data provided.

The detailed results of the Good Practice cases can be found in Appendix 1.



### 3.2 Urban Data Platforms in India

This section gives an overview on the stakeholder constellation around the ecosystem of the five focus Urban Data Platforms in India, followed by the thorough assessment of the platforms.

#### 3.2.1 Stakeholders

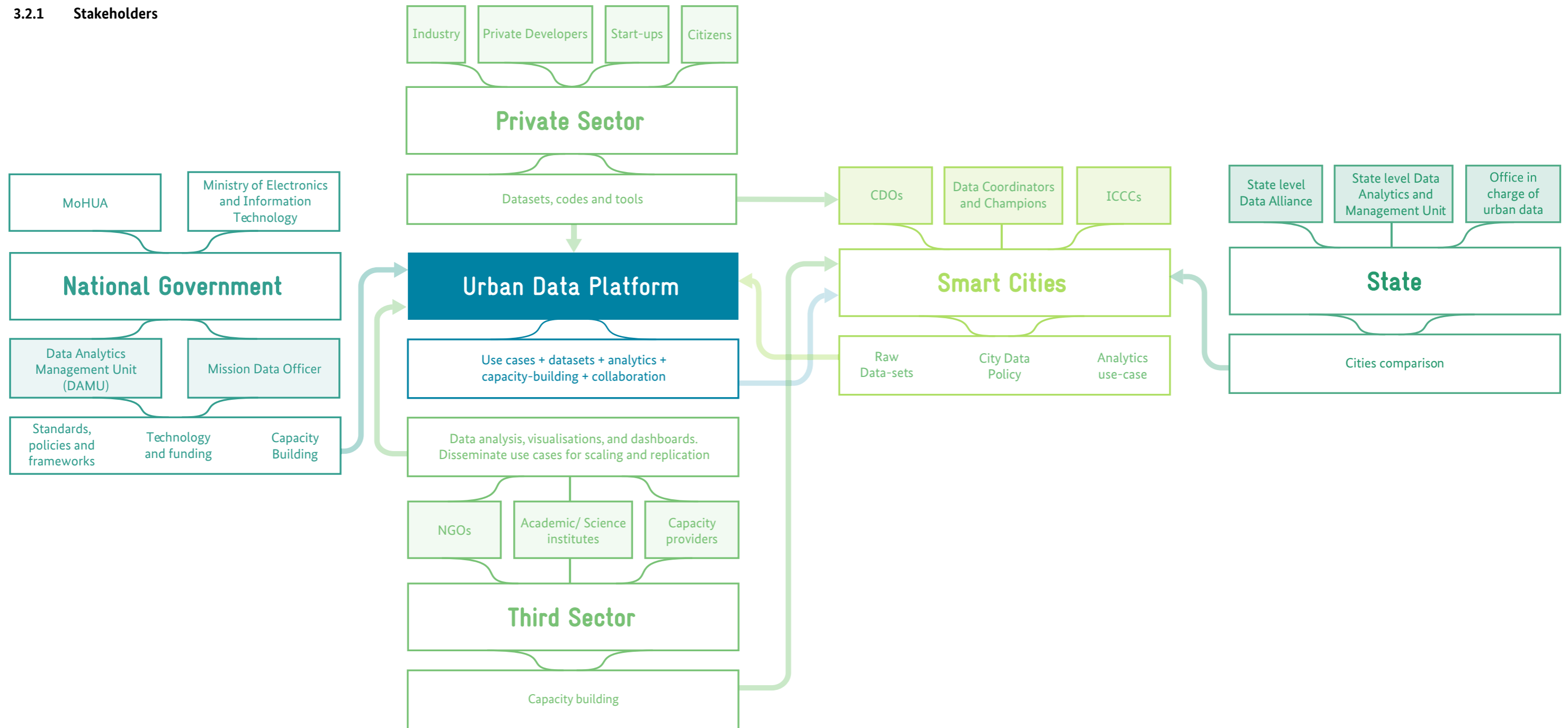


Figure 11: Stakeholders' roles and responsibilities relating to platforms (Buro Happold, 2023)

## National Government

The national government in India plays a significant role in the creation and management of Urban Data Platforms. With the following activities, the national government also managed to incentivize the 100 Smart Cities to use the national platforms:

- **Providing funding and technical support:** The government is responsible for funding and overseeing the development of these platforms, which typically involve collaboration between various government agencies, research institutions, and private organizations. The Ministry of Housing and Urban Affairs (MoHUA) has established several initiatives and schemes to fund Urban Data Platforms, smart city projects and other smart city infrastructure, such as the Smart Cities Mission (2021), as per this study.
- **Developing and implementing national data management policies and standards:** The government also sets policies and guidelines (Department of Science & Technology, 2012) for the collection, storage, and use of urban data on these platforms to ensure that data is being collected, managed, and used effectively to support urban management activities, and promote transparency and accountability. The Ministry of Housing and Urban Affairs (MoHUA) is the main body responsible for formulating policies and standards for urban data management in India. As represented in the policy review section, they interact in a strong collaboration with other bodies such as the National Institution for Transforming India (NITI) Aayog, the Ministry of Electronics and Information Technology (MeitY) and the Ministry of Statistics and Programme Implementation (MoSPI). The government may use the data to inform decision-making and policy-making at the national level. AMPLIFI (Ministry of Housing and Urban Affairs, 2020) for instance provides insights into the performance of different cities. National government uses this platform to identify urgent needs for investment and where financial support should be targeted towards.
- **Providing open-source data:** The Indian government also provides data on its Urban Data Platforms (Department of Science & Technology, 2012), collected from various sources such as censuses, surveys, and administrative records, especially on demographics, infrastructure and environment.
- **Regulating data access and security:** The national government, through the Ministry of Electronics and Information Technology (MeitY), is responsible for regulating data access and security, to ensure that data is protected and used ethically. For example, the Digital Personal Data Protection Bill (still in draft phases, soon to be enacted), and the National Data Sharing and Accessibility Policy (Department of Science & Technology, 2012) was approved in February 2012.

- **Coordinating with other national-level ministries:** The Smart Cities Mission is a mission within MoHUA. Through this mission, MoHUA coordinates with other national-level organisations, such as the National Informatics Centre (NIC) to promote the collection and use of data in urban areas. MoHUA also works in close collaboration with other ministries, such as the Ministry of Transport, the Ministry of Electronics and Information Technology, and the Ministry of Health to coordinate decision-making using analysis and results collected from data platforms for improvements of governmental related services.
- **Providing training and capacity building:** The national government, through various agencies and organizations, provides training and capacity building to city governments and other organizations to help them effectively use data in urban areas. The interview participants from national government commented that they regularly organise hackathons with City Data Officers (CDOs), Coordinators and Champions. Additionally, when the Smart Cities Mission was first introduced and the 100 Smart Cities were onboarded, all CDOs of those cities undertook a nationally-led induction programme into data-led urban development to ensure a consistent process across all cities.
- **Monitoring and evaluating data management activities:** The national government, through MoHUA, also monitors and evaluates data management activities to ensure compliance with policies and standards, and to identify areas for improvement. The Integrated Command and Control Centers (ICCCs) are centralized full-fledged facilities that are used to monitor, control and coordinate various activities related to urban management, such as traffic, transportation, public safety, and emergency response, and act as nerve centres for city operations. These centers typically use advanced technology such as surveillance cameras, sensors, and data analytics to gather and process information in real-time. They help city officials make data-driven decisions by providing them with accurate, timely, and actionable information. The Ministry of Housing and Urban Affairs (MoHUA) developed two cycles of Data Maturity Assessment Frameworks (Ministry of Housing and Urban Affairs, 2019) to evaluate the progress and performance of cities in implementing data initiatives the Smart Cities Mission (SCM) programs.

## City government

While the national government focuses on the management of Urban Data Platforms and the monitoring of their use, the Indian city governments on the other hand are responsible for collecting and managing the data available on those platforms on a wide range of urban-related topics, such as population, land use, infrastructure, transportation, and environmental conditions.

### City-level roles

City data officers, data champions, data coordinators and Integrated Command and Control Centers play an important role in managing and utilising urban data in India.

**City Data Officers (CDOs)** (MoHUA, 2019) lead the development and implementation of urban data management strategies, policies and systems within a city government. The CDOs act as a single point of contact to all internal and external stakeholders in the city. They work closely with other city departments and the national government (Smart Cities Mission, 2021) to ensure that data is collected, managed and used effectively to support urban management activities.

**Data champions** (MoHUA, 2019) are responsible for promoting the use of data within their own department and across the city government. They work with city data officers and other data coordinators to ensure that data is being used effectively to support decision-making and improve service delivery.

**Data coordinators** (MoHUA, 2019) assist data champions as reporting staff.

These roles also work closely with other stakeholders such as private organizations, research institutions and citizens, to gather and integrate data from various sources, and to ensure that data is accessible and transparent.

## City-level responsibilities

### Data collection and processing

Data is collected on Indian Urban Data Platforms using a variety of methods, including sensors and IoT devices, like traffic cameras, air quality sensors, and weather stations, which collect real-time data on various aspects of the city, such as traffic flow, air quality, weather conditions, GPS and location-based data from smartphones, public transportation vehicles, and delivery vehicles. This data can be used to track the movement of people and goods within the city. An example of this is in the city of Surat. A Surat representative was interviewed and shared that the city collects data on the IUDX platform through geotags in different parts of the city, sensors, devices and GPS such as Surat Money Open Loop Smart Card (Surat Municipal Corporation, n.d.), QR code-based ticketing, and Google's bus-related real time data. This collection method is especially promising as data gets updated automatically. Not only does this ensure real time data, but it helps the city to save on resources. Other sources of data collected manually has to go through a process of updating, which can take time and a lot of financial resourcing.

Manual data entry exists as well. This process is partly facilitated through user-friendly interfaces with standardized data input options. In AMPLIFI, CDOs need to enter specific data on KPIs related to their city on a regular basis using one interface across all cities.

Data is also being collected via crowdsourcing systems, through which citizens or the public may enter data manually through apps that directly feed into the data ecosystem. Many cities in India have implemented citizen engagement application portals. On those portals, the public is able to enter information in real time, often as registering complaints to the policy department or incidents and crimes relating to an emergency. This allows quick response from the authority in case of an accident, promotes community policing, enables citizens to interact with the police anonymously and empowers anyone to take responsibility of safety and security of their environment. It is also noteworthy that once inputted into the platform ecosystem, crowd-initiatives that have emerged without initial government involvement allow the latter to integrate them within more 'formal' urban development processes, and take them into account when planning the future of an area.

CDOs are responsible for cleaning and processing all this data collected via different channels, according to the data standards and policies developed by the national government before uploading them to the platforms (MoHUA 2019).

## Data use

Thus, city governments use Urban Data Platforms to inform the planning and management of their cities. Data is being used to identify patterns, trends, and issues related to urban growth, and to plan for transportation, housing, and infrastructure development accordingly. For example, the city of Varanasi has been working with Hitachi (Mohan et al., 2021) since October 2020 on its solid management system. Each waste pickup vehicle is equipped with a smartphone that is used to estimate the picked-up waste along with the exact vehicle location via GPS feed. This smart system, powered through IUDX, enables the city officials to identify anomalies and generate alerts in real time.

City governments have been using the data platforms to engage with external organisations, especially with industry and the private sector. As both examples above illustrated, ULBs have been working with tech and smart companies to collect data, and monitor and improve their services. Interviewees mentioned that this might be an opportunity for cities to monetise the data they collect, to sell to other companies down the line.

Finally, cities use Urban Data Platforms to engage with citizens and other stakeholders in the planning process, and to promote transparency and accountability in urban management. For instance, the city of Pune has been using its city-level Urban Data Platform and its feature “Citizen Connect” (Pune City Connect, n.d.) to engage its citizens. The platform enables citizens to register complaints, track their status, and provide feedback on the services provided by the government. A feature called “Project Monitoring” allows citizens to track the progress of various development projects in the city. Furthermore, the platform also has a feature called “Smart City Proposals” which helps citizens to propose new smart city projects and initiatives.

Overall, city government’s role in Urban Data Platforms is typically more hands-on and operational in nature, as they are the ones who collect, manage and use the data to improve the quality of life of the citizens in the city.

## Governance and integration into interfaces with municipal instruments and processes

The Indian government has been promoting the creation of Integrated Command and Control Centres (ICCC) (INNEFU, n.d.) in Indian cities as a way to improve the efficiency and effectiveness of city management. Indian cities are currently in the process of setting up their own ICCCs, or are in the process of upgrading existing systems to provide more comprehensive and integrated data management capabilities.

The integration of the nationally-provided Urban Data Platforms with the existing ICCC platforms at the city level has been key to make data sharing from different applications using standardized APIs possible. This way, the two systems can easily start sharing and consuming data thereby addressing challenges together. They therefore can share use cases, tools, ideas and other instruments to leverage each other’s potential in solving civic issues that needed data from more than one source. Indeed, ICCCs have been using data from Urban Data Platforms to predict future events and plan accordingly. This was notably the case in New Delhi during the COVID-19 pandemic, for which data extracted from its ICCC repository with plugged-in modules for various administrative, medical and field operations helped with forecasting the spread of the disease and predict the logistics requirements, active cases, positive patients, and death rate (Hasan et al., 2022).

Cities can also build unified operating environments and cross-lev-erage different strengths and authorities from operating systems. Nationally-led Urban Data Platforms allow ICCCs to integrate a variety of sensors, devices from different suppliers without investing in a different application every time or buy a particular field device, sensor, etc. This helps in saving on resources. They also provide mechanisms that ensure data control, access authorization and secure exchange to allow the city to build monetizable data sets in the future which could help sustain their operations.

Finally, this integration also helps with communication with various stakeholders for more effective coordination and collaboration in city management.

## State-level

Data-driven collaboration (Department of Science & Technology, 2012) can also happen at the state-level. Indeed, state departments and agencies play a crucial role in helping cities towards a digital transition in India.

The state acts as an interface between national and local governmental levels, and as a coordinator of all cities’ efforts within the same state. It takes on responsibilities of both national governments and cities governments (MoHUA, 2019).

Through state-level datahubs, states share datasets with their cities that is collected and available at the state level. This may include data from the department of commerce, statistics or water resources for example. Additionally, state level agencies also collate data from multiple sectors and thus offer a centralized data repository.

Some states have also created State Data Centres (SDC). Gujarat, West Bengal and Tripura are among those states. SDCs host applications and servers for different Government departments functioning within the State (MoHUA, 2019). Further, a few states have a State Informatics Officer (or Chief Data Officer for the State). They act as representatives of the National Informatic Centre (NIC) (National Informatics Centre, 2019) but at the state-level. They coordinate with the State Data Centre (SDC) and Directorate of Municipal Administration (DMA) and any other municipal data platforms (MoHUA, 2019).

States coordinate State Level Data Alliances, to enable cities within the same geography to collaborate, share lessons learnt and suggestions for improvement together (MoHUA, 2019). Those alliances are networks of smart cities and other ULBs, government departments, NGOs and academia. They can facilitate peer learning and can also act as a knowledge partner for training and capacity building on data.

Finally, states have established Data Analytics and Management Units, can roll-out appropriate state-level policies and may choose to identify additional cities to integrate within the Smart Cities Mission in addition to the 100 smart cities.

## Private sector

The Industry is not only consumer but also provider of data. Partnerships with private entities are already being established with cities to collect real-time data. Further, start-ups and the private sector are hubs and incubators for innovation and state-of-the-art technologies. Those are especially helpful to cities for creative data analytics and roll-out new data collection methods through pioneering applications.

For instance, Onyx Technologies have been working with IUDX and partner cities in installing Red Light Violation Detection cameras on existing infrastructure to synchronise its feed with the feed from traffic lights to create adaptive traffic modes and thus improved traffic flow/speed (Wen, 2008). Cities are able to use those analytics to inform future urban decision-making. Integrating this technology and its results into nationally established platforms enables city governments to use cases built for one city and easily implement them in their own. Further, this allows city administration to hold data centrally which otherwise might be difficult to obtain.

It is important to note that the national government however recommends working with smaller start-ups to contribute to their own growth and development.

Partnerships with the private sector will be key when exploring pathways to data monetisation, either to buy data from them or to sell them publicly-owned data for their own purposes. The private sector’s expertise in commercialising data may be a fundamental source of information towards this mission.

## Academia and Research

Academic and research institutions are partners in the development of the data standards and platforms on a national and city level. Further, academic institutions help with deploying further collaboration between cities. Academic research develops use cases and case studies to be shared with other cities for replication and further learning.

MoHUA for instance launched the Smart Cities and Academia towards Action & Research (SAAR) Programme (JournalsOfIndia, 2022) to document landmark projects of 75 smart cities to understand and showcase the practices and methods undertaken in the mission and help adopt the Good Practice for further projects, including Urban Data Platforms.

Additionally, IUDX has been collaborating with the Centre for Society and Policy in the India Institute of Science in Bangalore to assess economic, policy, legal, regulatory, and standardization issues involved in using public or privately owned data.

### 3.2.2 Platforms

Following the policy review and in coordination with MoHUA stakeholders, five Urban Data Platforms were shortlisted for further analysis. Those were prioritised based on purpose and functionality and assessed using the Assessment Matrix. This chapter starts with an overview of platforms, their services and interrelations. It then presents the findings from their assessment and continues with presenting how each platform is being used in practice by cities, using a non-exhaustive account of use cases, and subsequently giving an account of key opportunities, challenges and suggestions for development.

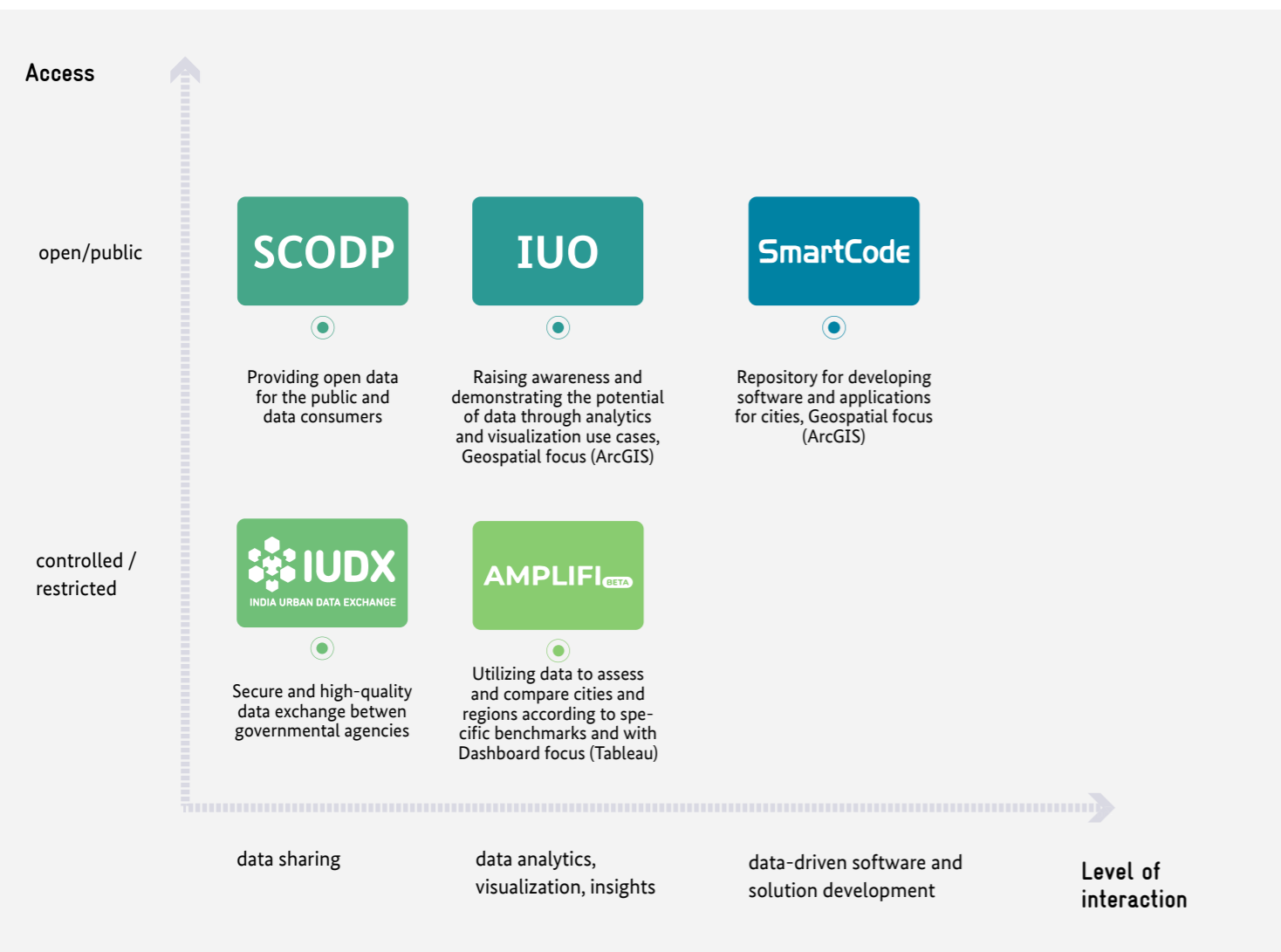


Figure 12: Platform services and interrelations (Buro Happold, 2023)

### Overview of the Platforms

Nationally-provided Urban Data Platforms were established by MoHUA and other national-level organizations to standardise the data collection and provision process, encourage wider collaboration and knowledge exchange, and ensure that data is stored in a single place. In the past, data-driven development was undertaken in silo, individually by city governments which developed their own Urban Data Platforms. This led to disparities between cities, as larger municipalities with more capacity could undertake such development, whereas ULBs with less resources were disadvantaged. Providing a centralized repository of various data sets generated by government agencies and other organizations aims to democratise data-driven development across the country (Department of Science & Technology, 2012).

#### Purpose of the Platforms

National Urban Data Platforms enable easier access and sharing of data, as well as the ability to integrate and analyse data from multiple sources, from different cities, from government agencies, research institutions, private organizations, and citizens, leading to more accurate and informed decision-making (MoHUA, 2019). This allows for a more comprehensive understanding of various aspects of the city, such as population, land use, infrastructure, transportation, and environmental conditions.

Additionally, these platforms help ensure the security and privacy of data, through the use of nationally established common data standards and protocols, and promote transparency and accountability in government operations.

The five Urban Data Platforms have all been developed between 2019 and 2022. They have different purposes, target groups, technologies and functionalities. All platforms are currently active for 100 Smart Cities (some for more) and are envisioned to be scaled up for all other cities in the country. Currently, the platforms have different levels of accessibility and interactivity. While [SCODP](#) has a high level of accessibility for data sharing but limited interactive functionality, [IUDX](#) is more interactive but provides restricted access. The [India Urban Observatory](#) provides insights and dashboard options for users with public access, whereas [AMPLIFI](#), through restricted access, allows cities to compare their urban development performance against others by sector. The [SmartCode](#) platform facilitates the open sharing of codes that can be integrated in application and digital solutions. The other two platforms do provide a publicly accessible interface as well. However, they also include restricted access to data and dashboards that is limited to stakeholders and users who are granted access rights by the platform providers.

There is also interaction between the different platforms. Some data platforms use APIs to enable access to data and services from other platforms. This supports the integration into and interfaces between national and city-scale instruments and processes. For instance, [IUDX](#) uses data shared on the SCODP through APIs. Additionally, all

data shared on the SCODP is available with API so that cities can use the data through their own portals.

#### Usability of the Platforms

In order to encourage the 100 Smart Cities to engage with the platforms, the national government has worked on a combination of incentives, which includes but is not limited to:

- Capacity building targeted at city stakeholders to collect and publish data, APIs and stories according to national standards
- Providing a user-friendly and simple interface for data entry (e.g. as in the case of AMPLIFI)
- Continuous monitoring of the performance and engagement of cities through the Data Maturity Assessment Frameworks
- Ranking and certifying cities according to their performance (e.g. as Connected Cities, Explorer, Initiator etc.)
- Considering data monetisation and data marketplaces to create financial incentives for cities to share their data

#### Platform Assessment

Each platform was assessed using the Assessment Matrix described in the methodology section. Findings are presented in the form of Urban Data Platform Fact Sheets. Those factsheets provide an account on how each platform performs in terms of the quality of the data provided, accessibility of the data and the usability of the platform by users. The aim of this assessment is to give answers to the following non-exhaustive questions:

- How accurate and complete is the data provided?
- How does it stay up-to-date?
- Where does data come from?
- Can data be downloaded and stored?
- How is data uploaded?
- How easy is data to find and use?
- Under what conditions can the data be used and for what purpose?

Each Key Performance Indicator (KPI) score is given under the Quality, Accessibility and Usability categories, together with the corresponding metric, and additional explanation of the scoring. Each Factsheet summarizes key challenges and opportunities for each platform for future growth and replicability into other contexts. Findings were complemented by information acquired during interviews with key stakeholders.

The aim of the platform assessment is to give information on each platform, how it is being used in practice and in which areas they complement each other, rather than evaluating or scoring their quality in general. Since the platforms have all been developed only in the last three years before this study and are continuously evolving even during the time of the study, it must be considered that the assessment is only capturing a moment of time.

## Smart Cities Open Data Portal (SCODP)

(MoHUA, 2012) [↗](#)

### Overview

General info: SCODP is a single point of access to datasets/apps in open format published by Chief Data Officers of Smart Cities. CDOs can share data across a variety of sectors for free access, download and use. The portal is designed to host open datasets of 100 Smart Cities of India and more than 5100 datasets are already uploaded on the portal for free access to the public.

**Responsible body: Centralised - National Government**  
Ministry of Housing and Urban Affairs (MoHUA)

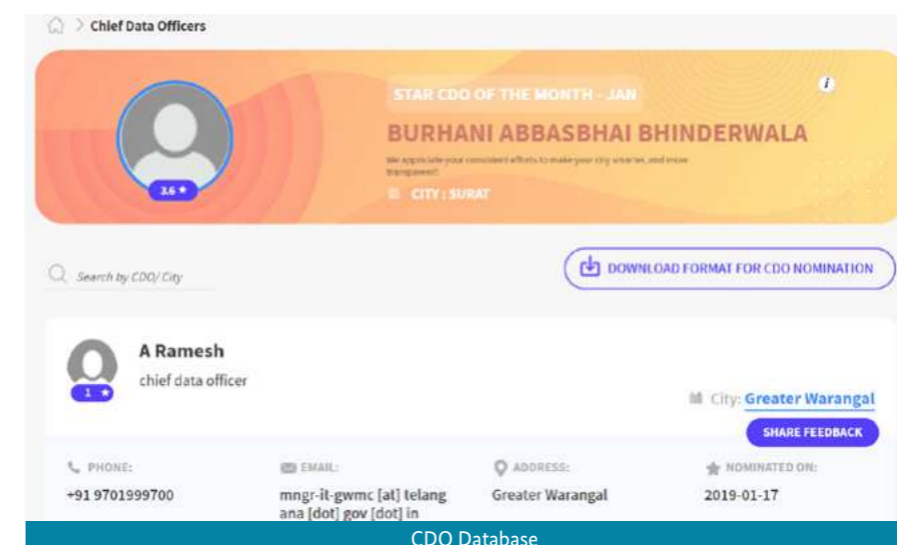
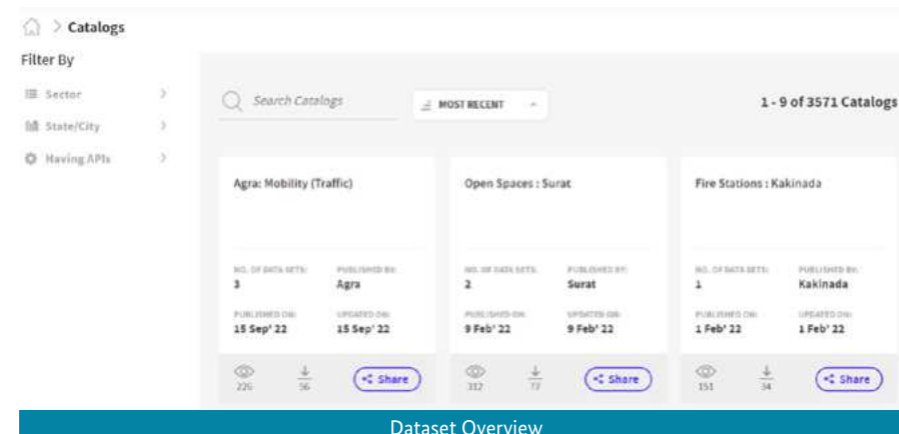
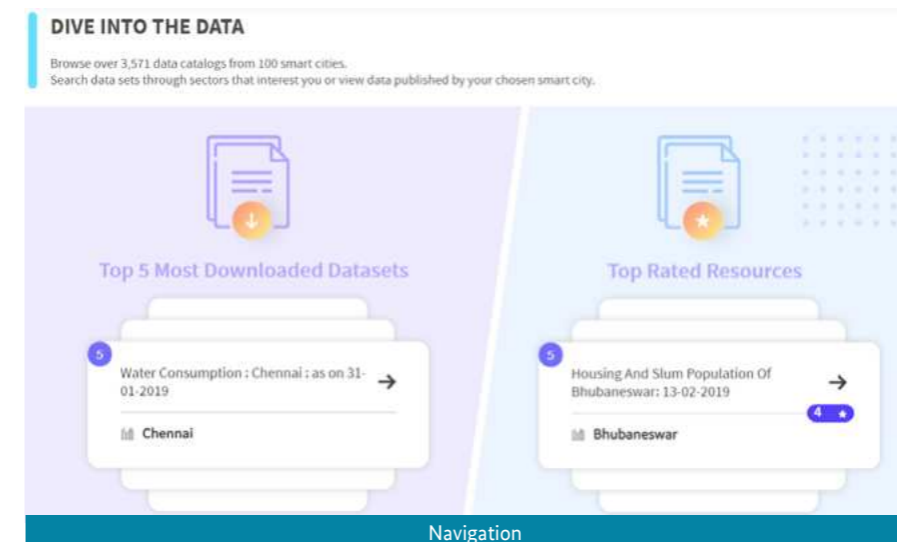
**User groups: Local Authorities/Municipalities/ ULBs/City officials, Universities/Educational Institutions, Private urban professionals**  
Municipal/Line Departments, Citizens, Research Institutes, Academia and Industries

### Sectors:

Agriculture, Art and Culture, Census and Surveys, Commerce, Defence, Economy, Education, Environment and Forest, Finance, Food, Governance and Administration, Health and Family Welfare, Home Affairs and Enforcement, Housing, Industries, Information and Broadcasting, Information and Communications, Infrastructure, Judiciary, Labour and Employment, Parliament of India, Power and Energy, Rural, Science and Technology, Social Development, Transport, Travel and Tourism, Urban, Water Resources, Water and Sanitation, Youth and Sports

### Partners and Collaborators:

Ministry of Electronics and Information Technology (MeitY), the National Informatics Centre (NIC), the National Institute of Urban Affairs (NIUA), NITI Aayog, various private sector organizations (like Microsoft, PwC and Cisco), academic institutions like the Centre for Study of Science, Technology and Policy (STEP), civil society groups promoting the use of open data in various sectors and industries, and the World Economic Forum



## Smart Cities Open Data Portal (SCODP)



### Quality

- **Accuracy:**  
*In terms of accuracy, the datasets in the platform are mostly 2D data/statistical data with a low level of detail.*
- **Precision:**  
*The datasets published on the platform are verified by the CDOs through cross-checking.*
- **Validity:**  
*The platform adheres to the International Open Data Charter's six principles for open data: availability and accessibility, reuse and redistribution, comparability, timeliness, completeness, and quality. The datasets uploaded by cities are also validated by the DAMU team at the national level before publishing.*
- **Transparency/Integrity:**  
*The responsible Chief Data Officer (CDO) and its contact details are published. There is limited detailed information about data source and methodology, however, since data is filled by the cities and their concerned departments themselves and templates are defined, it is understood that no methodology is necessarily required here.*
- **Completeness:**  
*Depending on data category, the datasets in the platform cover the 100 smart cities in India including Ahmedabad, Bangalore, Chennai.*
- **Timeliness:**  
*The level of upload frequency is defined for each dataset while uploading the dataset. Datasets are updated depending on the defined set frequency, which can be monthly, bi-annually, annually etc. The functionality is there but the update process differs from city to city.*



### Accessibility

- **Open data:**  
*The datasets in the platform include URIs to link related datasets and more context.*
- **Registration Requirements:**  
*Registration is required to access API.*
- **Format Diversity:**  
*There are more than 3 machine-readable formats including CSV, JSON, XML, XLS and ODS.*
- **Format Accessibility:**  
*Data is available to download in open and accessible formats and as API*
- **Guidance/Documentation:**  
*Guidelines, manuals, resource templates, help documents on using the data and the platform, and metadata are available.*
- **Storability:**  
*Stored data is available and usable for all users.*



### Usability

- **Performance:**  
*In terms of performance, this platform scores good as it has a low First Input Delay (FID) which quantifies the experience users feel when trying to interact with unresponsive pages.*
- **Multi-channel Access:**  
*User experience is consistent across PC, phone and tablet.*
- **Inclusion:**  
*The platform complies with GIGW guidelines. The platform does not offer language options other than English.*
- **Intuitivity:**  
*The platform is intuitive to use, both through navigation, such as Most Downloaded Datasets, Top Related Resources and through search functionality, such as Search by Sector/State/City/API availability.*
- **Interactivity:**  
*The platform is an interactive website with data download option. It also has a "Visualize tool" (which, however, was not yet fully operational at the time of writing).*
- **Storytelling:**  
*Use cases are visually demonstrated in Blog section with the details of their implementation.*



### Challenges

- Due to the large number of datasets available on the portal and updation varying from city to city, many datasets are not updated regularly, which limits their usefulness and timeliness in some urban contexts.
- Interactivity of the platform could be further developed, by bringing the visualisation tool to full operation, for example.



### Opportunities

- By providing access to open data, the platform provides a valuable resource for businesses, researchers, and developers to access and use government data to create new products, services, and insights. This also encourages collaboration as all users have equal access to data.
- Engagement and participation from the public and urban citizens is encouraged as they have easy and open access to government data and information, which empowers them to take part in the urban decision-making process.

Smart Cities Open Data Portal (SCODP)

	KPI ID	KPI					
<p>QUALITY</p>	Q1	Accuracy	Q1	Business as Usual			
	Q2	Precision	Q2	Business as Usual	Stretch	Pioneering	
	Q3	Validity	Q3	Business as Usual	Stretch	Pioneering	
	Q4	Transparency / Integrity	Q4	Business as Usual			
	Q5	Completeness	Q5	Business as Usual	Stretch		
	Q6	Timeliness	Q6	Q6	Business as Usual		
<p>ACCESSIBILITY</p>	A1	Open Data	A1	Business as Usual	Stretch	Pioneering	
	A2	Registration Requirements	A2	Business as Usual	Stretch		
	A3	Format Diversity	A3	Business as Usual	Stretch	Pioneering	
	A4	Format Accessibility	A4	Business as Usual	Stretch	Pioneering	
	A5	Guidance / Documentation	A5	A5	Business as Usual		
	A6	Storability	A6	A6	Business as Usual	Stretch	Pioneering
<p>USABILITY</p>	U1	Performance	U1	Business as Usual			
	U2	Multi-channel Access	U2	Business as Usual	Stretch		
	U3	Inclusion	U3	U3	Business as Usual		
	U4	Intuitivity	U4	U4	Business as Usual	Stretch	
	U5	Interactivity	U5	U5	Business as Usual		
	U6	Stroytelling	U6	U6	Business as Usual	Stretch	Pioneering

Quality

- SCODP covers all 100 Smart Cities and additional ones.
- Data is uploaded by cities themselves, ensuring their usability, representativeness of and transparency for users.
- CDOs and DAMU validate data before publishing using defined standards.
- Datasets have high level of detail, including information on metadata, source and year.
- Uploading frequency is defined by user.

Accessibility

- All datasets are openly accessible, including through APIs.
- Datasets are linked to wider data sources through non-proprietary open formats, URIs and links to other data.
- Datasets are available in three or more machine readable formats.
- SCODP incorporates guidelines, manuals and resource templates, as well as contact details for support.

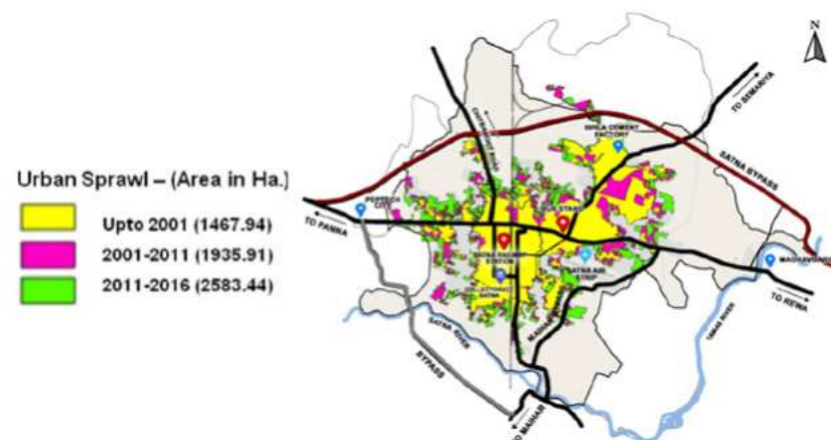
Usability

- The website is responsive and is visually stable.
- The platform can be accessed via different access points.

## Smart Cities Open Data Portal (SCODP)

### Use case

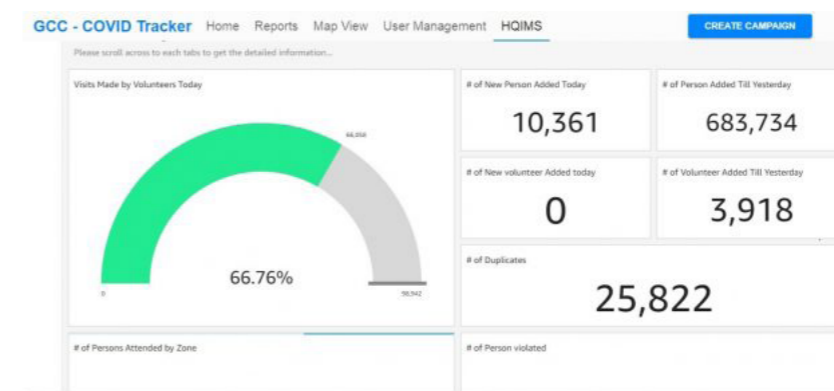
Many cities have been using SCODP to improve urban development systems and processes and ensure that decision-making is accurate and forward-thinking. For instance, the city of Satna has used mapping imagery provided on SCODP that highlights its urban area and its urban sprawl trends from 2001 to 2016 (Shyamsundar, 2022). The city was able to analyse this data to understand the direction and increase in the area covered so as to be better prepared for upcoming urbanization. It enables the city in projecting how and where the city will grow, the speed at which the population is growing and therefore how much residential space will be needed. Further, the analysis of the spread of residential space is helping the city to understand and prepare for the future needs of its population with respect to all the services including water supply, sanitation, lighting, revenue management, administrative services, etc (Shyamsundar, 2022).



**Caption: Satna: Analysis of urban sprawl for better planning; Source: Shyamsundar, Bahiram (2022).** [online] Available at <https://community.data.gov.in/satna-analysis-of-urban-sprawl-for-better-planning/>; [Accessed 2023].

The City of Chennai has also heavily used this platform to engage with its citizens. Chennai Smart City (CSCL) was tasked with collecting, collating, cleaning, streamlining and uploading 50 datasets which required heavy coordination logistics between different departments, overcoming staffing doubts on the need for this exercise and ensuring that data provided was correct. CSCL undertook a micro-level exercise and appointed a two-member unit to personally contact all the departments, to ensure the essence of this exercise and the benefits for the department. They also identified a data coordinator in each department, who was passionate and efficient in delivery. This ensured that CSCL uploaded more than 80% of the tasked datasets in the prescribed format within one month. This was a helpful exercise for the city for several reasons. It helped them identify issues within their data system, especially around the non-availability of city wide, zone and ward data of indicators and increase cross-departmental collaboration. For instance, robust statistical methods compliant with the requirements of the Open Data Portal were undertaken to aggregate the air quality location data, to arrive at a city-wide figure. Additionally, population had to be re-categorized by age groups which did not match the standard Census categorization. This engendered closer collaboration with the Census team.

Additionally, data-based approaches helped when combatting governance challenges during the COVID-19 pandemic. Chennai City leveraged the use of technology and data to employ one of the largest “Home Quarantine & Isolation Management Systems (HQIMS)” in the country. HQIMS established a systematic, process-driven monitoring and management system for citizens under Home Quarantine. On average over 30,000 citizens were monitored by this system daily. 18 different data sources helped to identify citizens needing home quarantine. The data collated was cleaned and demarcated zone wise.



**Caption: COVID-19 tracker on Open Data Portal. Source: Babu\_B\_V (2020) Open Data Platform: India Smart Cities blogpost: Chennai: Data-Driven Home Quarantine and Isolation Management System (HQIMS) | Open Government Data (OGD) Community.**

There are more than 85 use cases available on SCODP's blogpost community. It is important to note that while they do not cover all cities, those examples are important sources of information for other cities as the processes can be replicated in other contexts.



## Indian Urban Observatory (IUO)

(MoHUA, 2019) [🔗](#)

### Overview

General info: The IUO website acts as a repository of insights, visual resources and use cases aimed at instilling data culture in the urban ecosystem. It brings together people and institutions to work collaboratively with a common vision to use data for empowering communities.

### Responsible body: Centralised - National Government

Ministry of Housing and Urban Affairs (MoHUA)

### User groups: Citizens

Citizens, city officials, other government officials, industry, startups and academia

### Sectors:

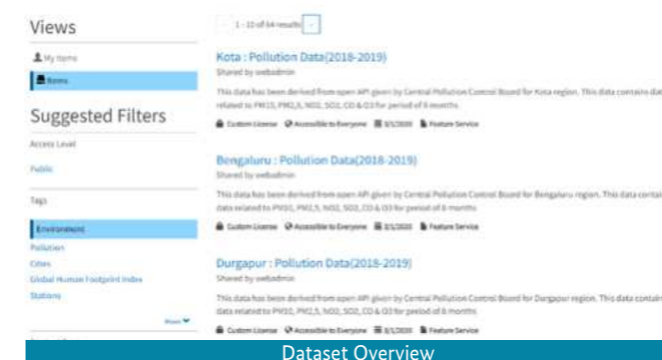
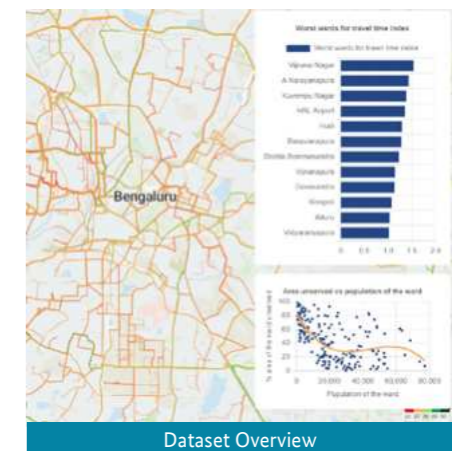
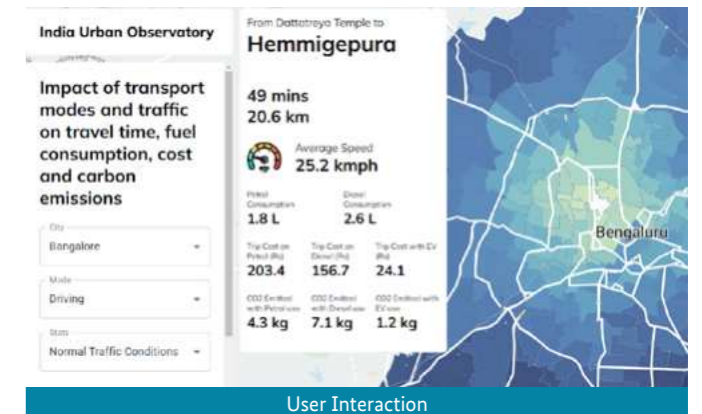
Water and Waste Water, Mobility, Environment, Energy, Solid Waste Management, Safety and Security, Municipal Finance, Health, Education, Housing, Sanitation

### Purpose: Data information, Collaboration and networking

To visualize use cases, using showcases further to gain insights for urban development and to connect and manage data from multiple sources including individual city IoT data platforms, non-IoT data sources, social media, open data and other third-party sources

### Partners and Collaborators:

The National Institute of Urban Affairs (NIUA), the Indian Institute of Technology (IIT) Delhi, UN Habitat, Environmental Systems Research Institute (ESRI), IIT- Delhi, Centre for Environment Planning & Technology (CEPT), ML infomaps, Geological Survey of India (GSI), state government departments, urban local bodies, and research institutions



## Indian Urban Observatory (IUO)



### Quality

- **Accuracy:**  
*2D data, low level of detail, live data*
- **Precision:**  
*The datasets published on the platform are verified and based on measurement.*
- **Validity:**  
*Data is sourced from the IUDX platform, other government data sources (such as the GSI portal, Bhuvan, data.gov.in etc.), and third party data sources (for example traffic data is sourced from Uber or Google, Cycling data from crowdsourced data or from STRAVA, remote sensing datasets from Landsat etc).*
- **Transparency/Integrity:**  
*Data source/publisher are given only by name/institution and there is a superficial mentioning of how the data was obtained. This means that there is no detailed information about data source and methodology.*
- **Completeness:**  
*Depending on data category, the datasets in the platform cover a limited number of cities. Since IUO is a phygital data lab, and the focus is on creating specific use cases, it is considered acceptable that not all cities are covered, but instead that use cases are replicable by other cities.*
- **Timeliness:**  
*The generation date of the data is known and current enough at the time of publication. However, it is not updated frequently enough to influence the appropriate level of decision-making.*



### Accessibility

- **Open data:**  
*Since data cannot be downloaded and viewed on the platform, the metric for this criterion is categorized as N/A.*
- **Registration Requirements:**  
*Registration is required to save datasets as favourites on the website*
- **Format Diversity:**  
*In the drop-down menu under download option there are more than 3 machine-readable formats including SHP, KML, XLS.*
- **Format Accessibility:**  
*Data is available to download in open and accessible formats and as API for users to interact with and use the features of the portal, although IUO is not designed as a data aggregator platform.*
- **Guidance/Documentation:**  
*User manual and metadata on using the data and platform are available.*
- **Storability:**  
*Stored data is available and usable for all users if the data catalogue has outdated data.*



### Usability

- **Performance:**  
*The platform has a good visual stability with low Cumulative Layout Shift (CLS).*
- **Multi-channel Access:**  
*User experience is consistent across PC, phone and tablet.*
- **Inclusion:**  
*The platform complies with GIGW guidelines. The platform does not offer language options other than English.*
- **Intuitivity:**  
*The platform is intuitive to use, both through navigation, such as Explore Visualisation by Categories/Scale (Global/National/State/City) and through search functionality, such as Search by Keyword.*
- **Interactivity:**  
*Platform enables live analysis and visualisation, however, without download option.*
- **Storytelling:**  
*Use cases are visually demonstrated in Gallery section with the storyboards and dashboards of showcases.*



### Challenges

- The quality of data varies depending on the source. Therefore, it is important for users to carefully review the documentation and metadata accompanying each dataset to ensure that it is accurate and reliable.
- The platform covers only individual use cases and therefore lacks completeness.



### Opportunities

- The platform can expand its coverage and data sources to include more detailed information on a wider range of topics, such as air and water quality, transportation, and public health.
- The platform provides a basis to develop more advanced analytics and visualisation tools that allow users to explore and analyse the data themselves.

Indian Urban Observatory (IUO)

	KPI ID	KPI				
<p>QUALITY</p>	Q1	Accuracy	Q1			
	Q2	Precision	Q2			
	Q3	Validity	Q3			
	Q4	Transparency / Integrity	Q4			
	Q5	Completeness	Q5			
	Q6	Timeliness	Q6			
<p>ACCESSIBILITY</p>	A1	Open Data	A1	N/A		
	A2	Registration Requirements	A2			
	A3	Format Diversity	A3			
	A4	Format Accessibility	A4			
	A5	Guidance / Documentation	A5			
	A6	Storability	A6			
<p>USABILITY</p>	U1	Performance	U1			
	U2	Multi-channel Access	U2			
	U3	Inclusion	U3			
	U4	Intuitivity	U4			
	U5	Interactivity	U5			
	U6	Stroytelling	U6			
				Business as Usual	Stretch	Pioneering

Quality

- Generation and upload date of data is known and current enough but not so frequently updated.
- Data originates from trusted sources, likewise available on IUDX and SCODP, as well as from other government data sources (e.g. the GSI portal, data.gov.in and Bhuvan) as well as third party data sources (e.g. live traffic data from Uber or Google, crowdsourced data from public apps like STRAVA, remote city sensors like from Landsat).
- Although information on data sources is limited, as IUO was designed as a phygital data lab, this is considered sufficient.

Accessibility

- IUO offers three or more machine readable formats of data insights as a drop-down menu, including SHP, KML, XLS.
- Some datasets are downloadable. However, as not a data aggregator platform, but rather a data visualisation tool, format accessibility is not crucial, thus downloading data is not necessary.
- Users can create their own web-based maps for insight.

Usability

- The platform is intuitive to use, with easily navigating menus and search items.
- It has varying levels of interactivity and displays live analysis. It allows users to test different data scenarios which are visually pleasing and engaging.
- IUO provides storyboards and use cases as examples.

## Indian Urban Observatory (IUO)

### Use case

IUO aims to foster a collaborative approach in addressing complex urban challenges by leveraging multi-disciplinary data for effective governance. The platform is assisting cities in gathering and developing data ecosystems that can be accessed by innovators to create citizen-friendly applications for data-driven governance and evidence-based planning.

The city of New Delhi has been doing exactly that. New Delhi Municipal Council (NDMC) worked with the IUO, by using some of its 3,000 available datasets, in creating a use-case or a prototype to analyse pollution data and identify factors responsible for such high levels of bad air at hotspots in areas around the city. Data was sourced from 18 environment sensors installed by NDMC and environment agencies. Further, traffic-related information was analysed through the platform (Delhi News, 2019).

This has in turn supported the city in using data to push its environment-friendly initiatives. For instance, it helped in planning and identifying new areas of high pollution, and convincing stakeholders on the need to pedestrianize certain areas and push for the use of non-motorised transport.



**Caption: Air Quality Indicators for Cities on IUO Dashboard; Source: Ministry of Housing and Urban Affairs (2019). Leveraging Big data in Smart cities. [online] Available at <https://iuo.mohua.gov.in/portal/sharing/rest/content/items/fa743e2971154a18a58d1da28990d879/data> [Accessed 2023].**

The city has also worked with a start-up that crowd-sources data. The data consisted of 1,000 outdoor photographs uploaded by volunteers to the server. An artificial intelligence (AI)-driven system then produced predictive and prescriptive analytics and generated a daily heat map of the city's cleanliness score. This encourages the administration to improve city services (MoHUA, 2019).

## India Urban Data Exchange (IUDX)

(MoHUA, 2021) [↗](#)

### Overview

- The India Urban Data Exchange (IUDX) is an initiative of the Ministry of Housing and Urban Affairs (MoHUA) and is implemented by the Indian Institute of Science (IISc). It is designed to serve as a secure platform for the exchange of urban data among stakeholders in the Indian urban sector, including government agencies, research institutions, and private organizations.
- The IUDX platform is open source, based on an underlying framework of open standard APIs and data models. Some of the principles of the platform are: data migration across silos, controlled data sharing across administrations, sharing of data without compromising privacy and security, compliance with international and domestic standards, reuse of software, lesson sharing between cities
- The platform is considered complementary to SCODP, shifting from Open Data, where all data is freely available, towards Data Exchange, where data is shared according to policy and business model.

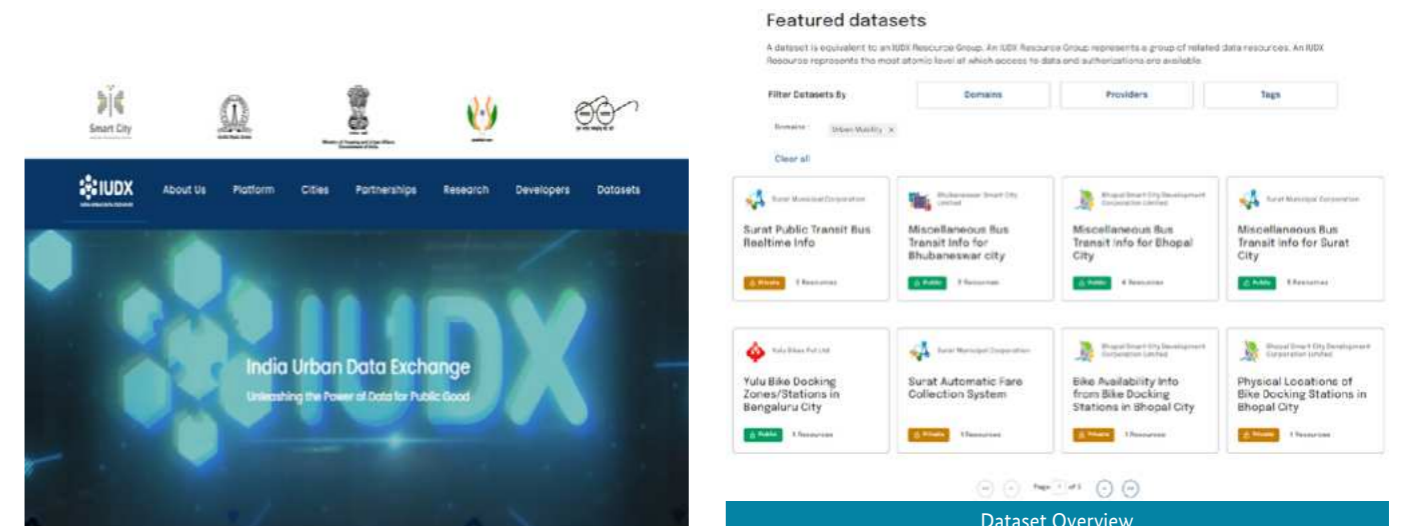
**Responsible body: Centralised - National Government**  
Ministry of Housing and Urban Affairs (MoHUA)

**User groups: Local Authorities/Municipalities/ULBs/Private urban professionals**  
Data providers, Academia/Research and Development, Citizens, City Administrations, Industry/Start-ups, App Ecosystems

**Sectors:**  
Environment, Waste Management, Street Light, Video Systems, Workplace, Urban Mobility, Civic and Energy

**Purpose: Data information, Collaboration and networking, Data repository**

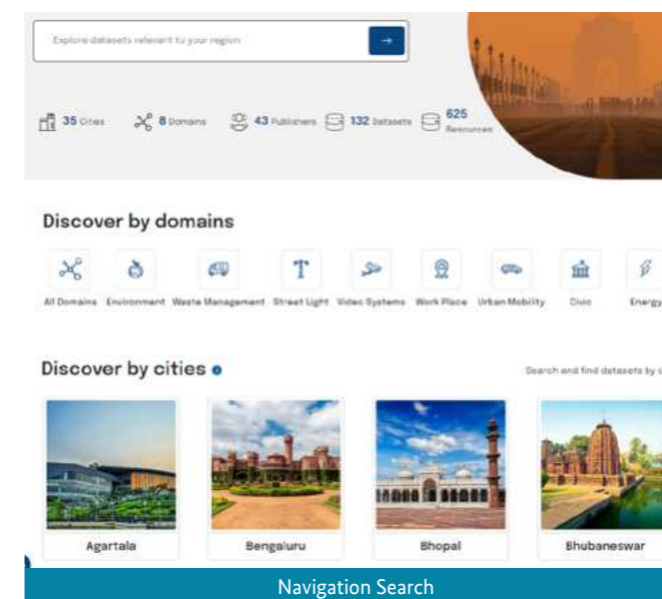
**Partners and Collaborators:**  
Indian Institute of Technology Bombay (IITB), Indian Institute of Science (IISc) Bengaluru, National Informatics Centre (NIC), and Smart Cities Mission are the main stakeholders who built the IUDX platform. Data Providers on the platform include various smart cities corporations (such as Agra Smart City Ltd. or Bengaluru Smart City Limited) and city authorities (such as Electronics City Industrial Township Authority in Bengaluru) as well as private sector companies (such as Yulu Bikes Pvt Ltd). Consumers and collaborators can include academic institutions and research organizations, other government entities, cities and states, private sector companies and service providers as well as civil society.



Dataset Overview



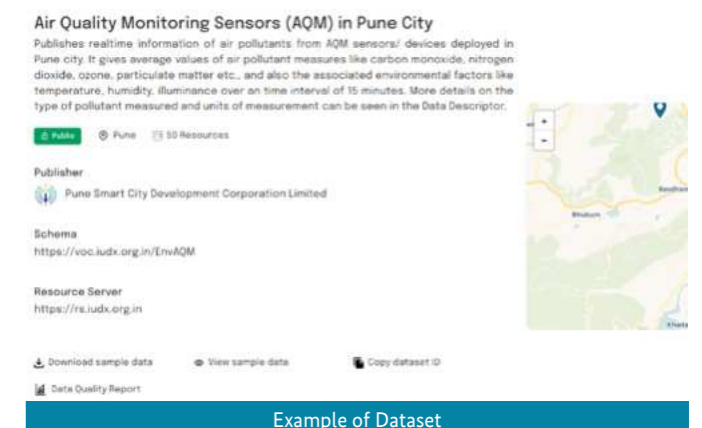
Main Page



Navigation Search



Use Cases



Example of Dataset

## India Urban Data Exchange (IUDX)



### Quality

- **Accuracy:**  
*Varying degrees of accuracy depending on the dataset, but partly realtime information from sensors.*
- **Precision:**  
*The datasets published on the platform are verified and based on measurement.*
- **Validity:**  
*The datasets adhere to national standards and guidelines such as National Data Sharing and Accessibility Policy. Providers can include additional user policies.*
- **Transparency/Integrity:**  
*The publisher/resource servers are stated and further information on data and methodology is provided in the Data Descriptor.*
- **Completeness:**  
*Platform includes currently 67 cities in India with selected datasets from different categories. Engagement with additional cities is ongoing.*
- **Timeliness:**  
*Partly realtime data is available. Partly data not updated regularly in short intervals.*



### Accessibility

- **Open data:**  
*Data is available in non-proprietary open formats and partly includes URIs and links to other data.*
- **Registration Requirements:**  
*No registration required for selected public datasets. Login/registration is required to see map view and to request data which is tagged as private. Data Providers need special access rights.*
- **Format Diversity:**  
*Data is available mainly as JSON, but includes other various machine-readable format, such as CSV, GeoJSON, RDF and XML.*
- **Format Accessibility:**  
*The API can be accessed by clicking on the link under Resource Server on the relevant dataset page. In the "IUDX Resource Server APIs" tab users will find the necessary information about the API and the contact details for support. Data can also be downloaded in other formats.*
- **Guidance/Documentation:**  
*Manuals and guidelines on using the data and platform, such as Getting Started, Discovering and Consuming Datasets, Add your data resources to IUDX, Manage Access Control of your data resources, Contribute to IUDX, are available. Further, a complete repository with technical guides is available under Knowledge Center.*
- **Storability:**  
*There is no dedicated data archive, however, historical data is partly included within the datasets.*



### Usability

- **Performance:**  
*Platform has a good visual stability with low Cumulative Layout Shift (CLS), but a poor LCP (largest contentful paint) resulting in lower speed.*
- **Multi-channel Access:**  
*User experience is consistent across PC, phone and tablet.*
- **Inclusion:**  
*The platform complies with GIGW guidelines. The platform does not offer language options other than English.*
- **Intuitivity:**  
*The platform is intuitive to use, both through navigation, such as Discover by Cities/ Domains, Featured and Recent Datasets and through search functionality, such as Search by Region.*
- **Interactivity:**  
*The platform includes a dashboard for consumers and providers to track own behaviour and activities, but not to interact with the data itself.*
- **Storytelling:**  
*Brief description of use cases, their impacts and IUDX's contribution to each use case are published in PDF format under Partnership section. Further, case studies are detailed and visualized under the Knowledge Center.*



### Challenges

- Ensuring the continuous contribution of the cities and other data providers (e.g. bike companies, city authorities) according to a unified standard.
- Possible waiting times to gain access for requested datasets can lead to inefficiencies.



### Opportunities

- Secure exchange of data increases the trust of stakeholders in sharing and utilising the data for decision-making.
- IUDX gives the data provider the option to make data public or not and to define specific user policies. SCODP and IUDX can therefore complement each other by catering to different target groups.
- Integrated dashboard enables consumers and providers to monitor the activities on the platforms, thus providing direct insights into the impact.

India Urban Data Exchange (IUDX)

	KPI ID	KPI				
<p>QUALITY</p>	Q1	Accuracy	Q1			
	Q2	Precision	Q2			
	Q3	Validity	Q3			
	Q4	Transparency / Integrity	Q4			
	Q5	Completeness	Q5			
	Q6	Timeliness	Q6			
<p>ACCESSIBILITY</p>	A1	Open Data	A1			
	A2	Registration Requirements	A2			
	A3	Format Diversity	A3			
	A4	Format Accessibility	A4			
	A5	Guidance / Documentation	A5			
	A6	Storability	A6			
<p>USABILITY</p>	U1	Performance	U1			
	U2	Multi-channel Access	U2			
	U3	Inclusion	U3			
	U4	Intuitivity	U4			
	U5	Interactivity	U5			
	U6	Stroytelling	U6			
				Business as Usual	Stretch	Pioneering

**Quality**

- IUDX covers currently 35 cities through public datasets, but offers more specialised and specific data.
- The platform follows a rigorous data validity process. Datasets adhere to national standards and guidelines such as the National Data Sharing and Accessibility Policy.
- Data generation date is available, but frequency of upload is partly unknown.

**Accessibility**

- Different options for consumers, providers and delegates, whereas consumers need to request access from providers to gain full access.
- Various options to access data, including APIs and download of JSON.
- IUDX provides manuals and guidelines on using the data and platform as well as a user-specific consumer and provider dashboard to monitor activity and behaviour.

**Usability**

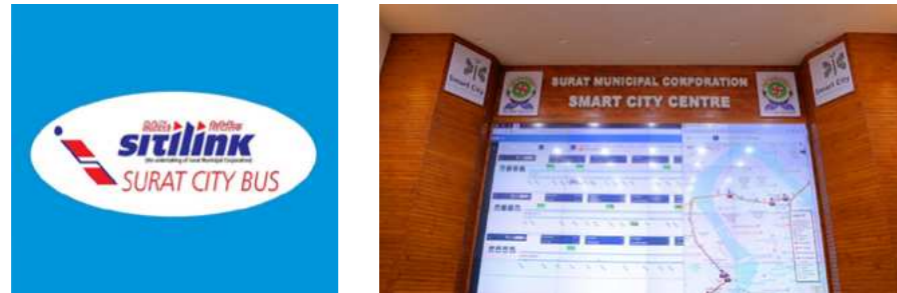
- IUDX offers a good user experience, with responsive webpages and visual stability, with room for improvement on speed.
- The platform can be equally accessed on PC, tablets and phones.
- IUDX provides use cases which allows visualisation on how and what for data can be used, as well as types of collaboration it can engender.

## India Urban Data Exchange (IUDX)

### Use case

IUDX is a cloud-based software platform that aggregates data into a standardised repository or catalog server and transfers data into a common form from sources to applications through a resource server. The city of Surat has been using IUDX to improve transportation management, specifically in the area of traffic congestion (Surat Municipality, 2021).

The city has worked with the company NEC to integrate data from various sources, including traffic cameras, GPS data from public transportation vehicles, and social media data, into the IUDX platform to then develop a multimodal transport app called Sitalink. This data was analyzed using advanced algorithms identifying patterns and trends in traffic flow and bus occupancy (Surat Municipality, 2021).



**Caption:** LIVE Monitoring of BRTS / City Buses from Command and Control Center; Source: Surat Municipality (2021). ITS APPLICATIONS IN SMART CITIES Surat's Perspective Webinar. [online] Available at: [ITS APPLICATIONS IN SMART CITIES Surat's Perspective Webinar](https://indiairf.com/wp-content/uploads/2021/07/03_Use-of-IT-system-in-Traffic-Management_Surat.pdf). [online] Available at [https://indiairf.com/wp-content/uploads/2021/07/03\\_Use-of-IT-system-in-Traffic-Management\\_Surat.pdf](https://indiairf.com/wp-content/uploads/2021/07/03_Use-of-IT-system-in-Traffic-Management_Surat.pdf) [Accessed 2023].



**Caption;** Map showing different Transit Performance Indicators (ridership; revenue/bus; vehicle utilisation; earning/ km; cost/ km; accident rate, load factor, occupancy ratio); Source: Surat Municipality (2021). ITS APPLICATIONS IN SMART CITIES Surat's Perspective Webinar. [online] [online] Available at [https://indiairf.com/wp-content/uploads/2021/07/03\\_Use-of-IT-system-in-Traffic-Management\\_Surat.pdf](https://indiairf.com/wp-content/uploads/2021/07/03_Use-of-IT-system-in-Traffic-Management_Surat.pdf) [Accessed 2023].

Using this information, the city has been able to improve traffic management by adjusting traffic signal timings, rerouting vehicles and providing real-time traffic information to citizens through a mobile application. The city also used the data to plan for the introduction of new transportation infrastructure and services, such as dedicated bus lanes and bike-sharing schemes (Surat Municipality, 2021).

Additionally, the city also uses IUDX to share data with other organizations, such as the state transportation or police department, to improve coordination and collaboration in transportation management.

Further, the data team in Delhi and experts from Indian Institute of Science (IISc) and the private company Safetipin, are developing a women safety index for routes in Pune, following major concerns around women safety in the city. This tool will help people make an informed decision on which route to take depending on how safe it is. The application aggregates data from different sources on information such as real-time status of streetlights, past crime records, presence of police stations and bus stops, land-use of areas on the route, crime rate (Punekarnews, 2022).



**Caption:** An ad for 'my safe Pune app'; Source: Punekarnews (2022) Women Share List Of Unsafe Spots With Pune Police Through 'My safe Pune' App. [online] Available at <https://www.punekarnews.in/women-share-list-of-unsafe-spots-with-pune-police-through-my-safe-pune-app/> [Accessed 2023].



## Assessment and Monitoring Platform for Liveable, Inclusive and Future-ready Urban India (AMPLIFI) (Ministry of Housing and Urban Affairs, 2020) [🔗](#)

### Overview

General info: Ministry of Housing and Urban Affairs (MoHUA) has launched the Assessment and Monitoring Platform for Liveable, Inclusive and Future-ready Urban India (AMPLIFI) to support the Indian cities to become liveable, inclusive and future-ready by providing them with a tool to measure their performance across a range of indicators and to identify areas for improvement, as well as to track their progress over time. The released version is the Beta version of the AMPLIFI portal. Today, although access-based, AMPLIFI offers data visualization, insights and analysis across more than 800 indicators. City representatives are required to enter the data on an annual basis. It is envisioned, however, that AMPLIFI becomes a centralized urban data hub.

**Responsible body:** Centralised - National Government  
Ministry of Housing and Urban Affairs (MoHUA)

**User groups:** Anyone/Public, Local Authorities, State Authorities, Private Urban Professionals, Citizens, Universities/Educational Institutions

Government officials, urban planners, architects, developers, and researchers who are working on urban development and planning projects, citizens and community groups who are interested in monitoring and assessing the liveability and inclusivity of their cities

### Sectors:

Infant Toddlers & Caregiver-Friendly Cities, Mobility, Green Cover, Water, Sanitation and Hygiene (WASH), ULB Budget, Planning Preparedness, Disaster Management, Crime, Energy, Health, Education, Solid Waste, Demography, Economy, Environment, Finance, Governance and IT, Housing, Safety and Security

**Purpose:** Data information, Collaboration and networking, Data repository

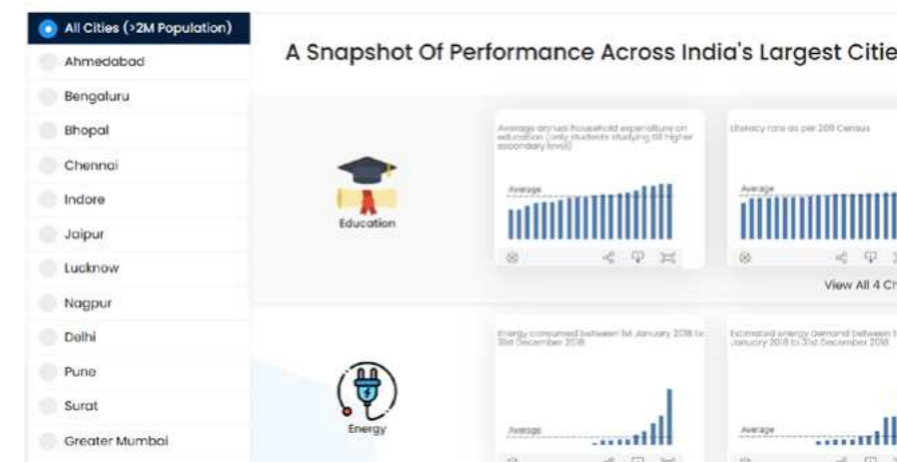
To monitor the implementation of smart city projects and the progress of cities towards becoming smart and sustainable, facilitating data-driven decision-making by providing data visualisation and analysis tools and promoting transparency and accountability in the urban development sector by making data and information publicly available

### Partners and Collaborators:

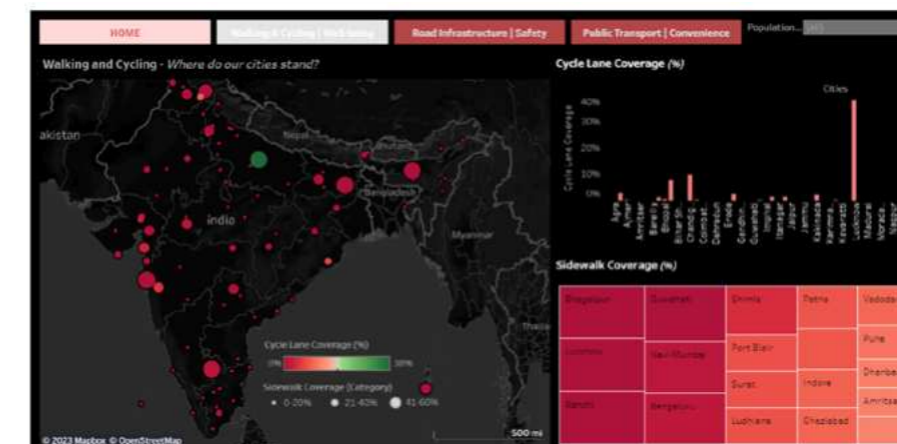
Government agencies, such as the National Informatics Centre (NIC), and non-government organizations, such as urban planning and development organizations and research institutions.



Main Page



Performance Analysis



Dashboard

## Assessment and Monitoring Platform for Liveable, Inclusive and Future-ready Urban India (AMPLIFI)



### Quality

- **Accuracy:**  
*The data includes KPIs and statistics on a city level.*
- **Precision:**  
*The platform offers a high level of detail, with defined metadata, source, and year of publication for each database, uploaded by cities themselves.*
- **Validity:**  
*International standards for data quality and metadata are expected to be considered.*
- **Transparency/Integrity:**  
*Information on data sources, metadata is available once platformed is accessed. Home page dashboards are made from actual data submitted by cities themselves.*
- **Completeness:**  
*Depending on the category, the datasets presented in the dashboards in the platform cover all smart cities in India and additional cities, where applicable.*
- **Timeliness:**  
*Data is envisioned to be updated on an annual basis.*



### Accessibility

- **Open data:**  
*This is an access-based platform so the data is not open.*
- **Registration Requirements:**  
*No registration required and no fees or subscriptions to view and download the demo dashboards. However, for viewing the complete datasets, user accounts are required and need to be granted access.*
- **Format Diversity:**  
*Several machine readable formats are available.*
- **Format Accessibility:**  
*Formats are accessible via machine readable formats.*
- **Guidance/Documentation:**  
*Manuals and guidelines on using the data and platform are available.*
- **Storability:**  
*Data is submitted by cities annually and stored along with historic data across years.*



### Usability

- **Performance:**  
*Platform has a good visual stability with low Cumulative Layout Shift (CLS) and a low First Input Delay (FID).*
- **Multi-channel Access:**  
*User experience is consistent across PC and tablet.*
- **Inclusion:**  
*The platform complies with GIGW guidelines. The platform does not offer language options other than English.*
- **Intuitivity:**  
*Navigation to view the visualisations under Explore Visualisations or Discover by Cities/data points, trending cities and recent searches.*
- **Interactivity:**  
*Platform has integrated dashboard which shows live analysis and visualisation using Tableau interface with a download option of dashboard in PDF, pptx and jpeg format.*
- **Storytelling:**  
*Use cases and examples covering various sectors are available on the platform.*



### Challenges

- Platform is still in its beta version, so not usable to all cities which could be seen as a challenge.



### Opportunities

- Platform allows cities to easily enter data through a user-friendly interface.
- The platform enables sharing of data between cities, organizations, and stakeholders to collaborate and find solutions to common urban challenges.
- The potential of this platform is to support the Indian cities to become liveable, inclusive and future-ready by encouraging sustainable development.

**Assessment and Monitoring Platform for Liveable, Inclusive and Future-ready Urban India (AMPLIFI)**

	KPI ID	KPI				
<p>QUALITY</p>	Q1	Accuracy	Q1			
	Q2	Precision	Q2			
	Q3	Validity	Q3			
	Q4	Transparency / Integrity	Q4			
	Q5	Completeness	Q5			
	Q6	Timeliness	Q6			
<p>ACCESSIBILITY</p>	A1	Open Data	A1	N/A		
	A2	Registration Requirements	A2			
	A3	Format Diversity	A3			
	A4	Format Accessibility	A4			
	A5	Guidance / Documentation	A5			
	A6	Storability	A6			
<p>USABILITY</p>	U1	Performance	U1			
	U2	Multi-channel Access	U2			
	U3	Inclusion	U3			
	U4	Intuitivity	U4			
	U5	Interactivity	U5			
	U6	Stroytelling	U6			
				Business as Usual	Stretch	Pioneering

**Quality**

- Data sources and metadata are available upon logging in.
- Data comes from the cities themselves through a standardized data-entry interface, so the level of detail and transparency of dashboards and analytics is high.
- AMPLIFI focuses on the 100 Smart Cities plus a selected number of additional cities, depending on the data category.

**Accessibility**

- AMPLIFI has limited access as it is an access-based platform.
- Platform provides several machine readable formats.
- It does not provide interactive map creation, but allows cities to test various variables and scenarios, and examine how their performance compares to other cities and regions.
- User manuals and metadata is available on the platform for help and support.

**Usability**

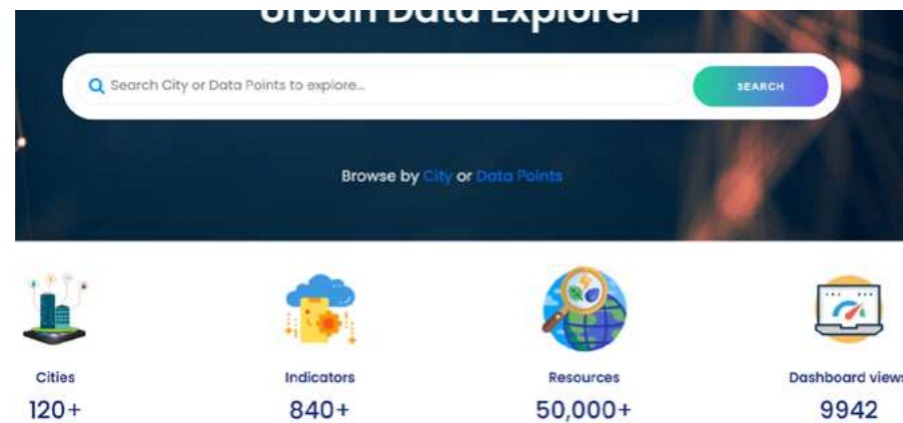
- AMPLIFI scores and performs well in this domain. It is intuitive to use, and is highly interactive for the user.
- The platform offers interactive dashboards which allow cities to compare their performances against others, selecting sectors and areas of interest.
- Insights and evaluations are visually pleasing and display live analysis.

## Assessment and Monitoring Platform for Liveable, Inclusive and Future-ready Urban India (AMPLIFI)

### Use case

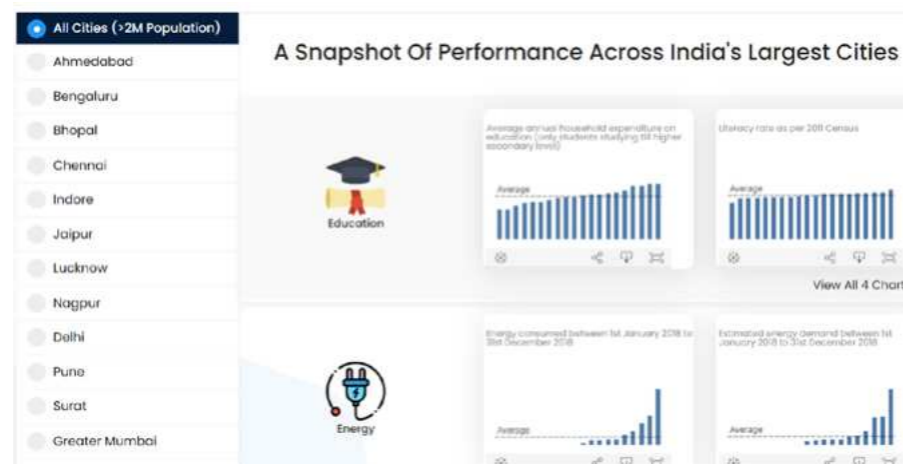
AMPLIFI is still being tested, however, some interesting analytics have already been created giving an idea of the platform's functionalities. Therefore, this section offers an overview of these functionalities rather than a city-related use case.

The platform allows cities to select different data points from over 840 indicators, from different sectors and states. Some examples of indicators are number of households, number of citizens, green cover area etc. (MoHUA, 2020).



Caption: Indicators available on AMPLIFI; Source: Ministry of Housing and Urban Affairs (2020) AMPLIFI [online]. Available at: <https://amplifi.mohua.gov.in/> [Accessed 2022].

The different data points are then aggregated into a single dashboard which provides sectoral analysis of cities over data points.



Caption: Featured Data Points on AMPLIFI; Source: Ministry of Housing and Urban Affairs (2020) AMPLIFI [online]. Available at: <https://amplifi.mohua.gov.in/> [Accessed 2022].

Various visualisations are then created through user-friendly interfaces. The dashboard below, for example, shows how different cities perform in terms of green cover per capita. The user is able to see how its city performs compared to others. For instance, the city of Jaipur, performing lower than others in some examples, could collaborate with the city of Gwalior, which is scoring high to understand Good Practice and what interventions could be implemented or where investment should be focused (MoHUA, 2020).



Caption: Environment Dashboard comparing performance of different Smart Cities on AMPLIFI; Source: Ministry of Housing and Urban Affairs (2020) AMPLIFI [online]. Available at: <https://amplifi.mohua.gov.in/> [Accessed 2022].

## SmartCode

(NIUA, 2021) [🔗](#)

### Overview

General info: Ministry of Housing and Urban Affairs (MoHUA) has launched the SmartCode Platform and it is developed by the National Institute of Urban Affairs (NIUA). SmartCode is a platform that enables all ecosystem stakeholders to contribute to a repository of open-source code for various solutions and applications for urban governance. It is designed to address the challenges that ULBs face in the development and deployment of digital applications to address urban challenges, by enabling cities to take advantage of existing codes and customize them to suit local needs, rather than having to develop new solutions from scratch.

As a repository of open-source software, the source code available on the platform is free to use without any licensing or subscription fees.

### Responsible body: Centralised - National Government

Ministry of Housing and Urban Affairs, National Institute of Urban Affairs

### User groups: Local Authorities/Municipalities/ULBs/City officials, State Authorities, Private urban professionals, Universities/Educational Institutions

Open-source Developers, Governments, Start-ups, Academia/Students, Industries

### Sectors:

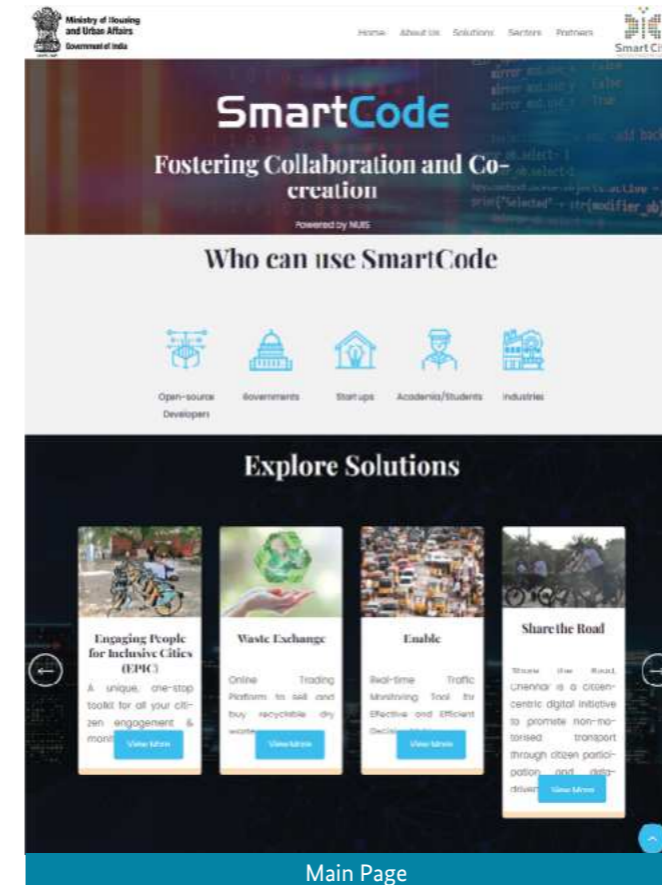
Digital Housing Repository, Water Security, Public Spaces, Digital Intervention of Street Vendors, Engaging People for Inclusive Cities, Waste Exchange Online Trading, Real-time Traffic Monitoring Tool

### Purpose: Data information, Learning and Development, Collaboration and Networking, Developing/Coding

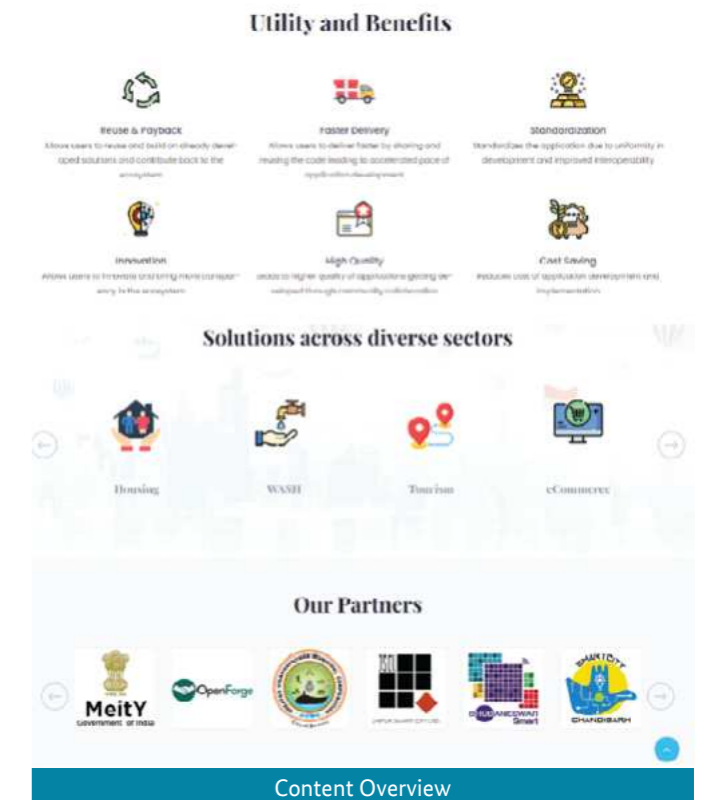
To support the planning, design and implementation of smart city projects in India by providing a comprehensive and up-to-date repository of codes, information, knowledge and Good Practices on smart cities. The platform includes information on Good Practices, case studies, training resources, and a variety of other resources to support cities in their efforts to create more sustainable and livable communities.

### Partners and Collaborators:

Government agencies, urban planners, researchers, private sector, citizens, national and international organizations, research institutions, and experts in the field of smart cities and urban development such as Open Forge, City of Destiny, Jaipur Smart City, Smart city Chandigarh.

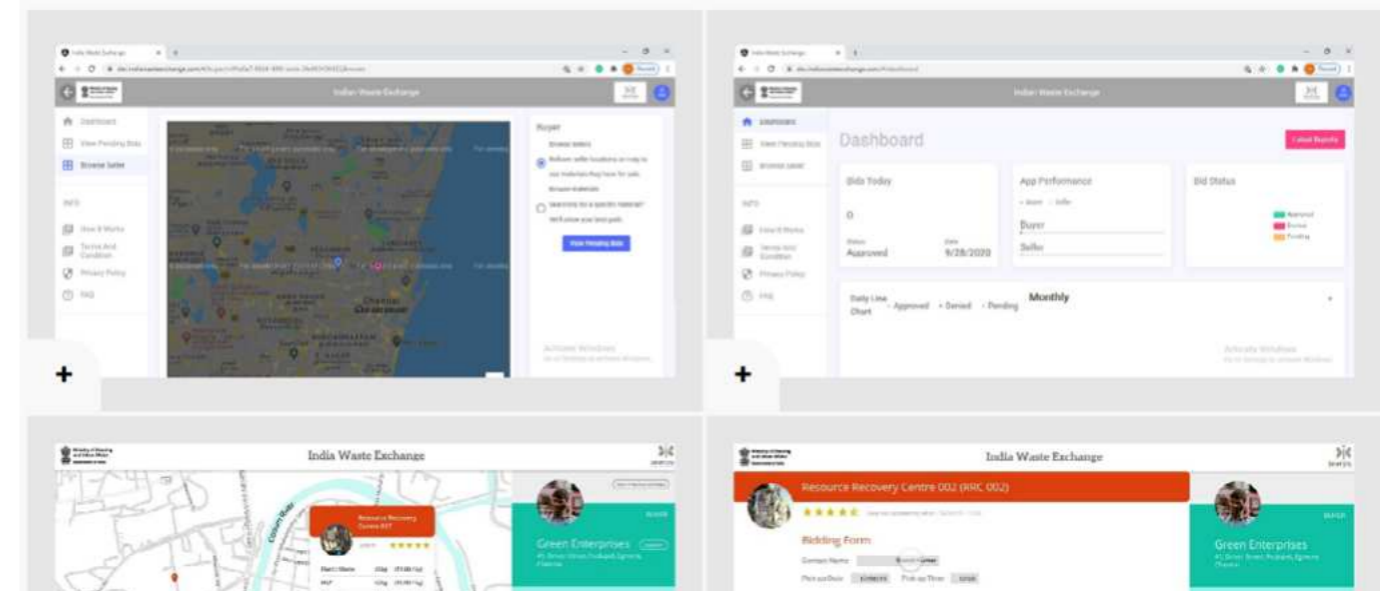


Main Page



Content Overview

## Product Snapshots



Use Case Overview

## SmartCode



### Quality

- **Accuracy:**  
*Codes are being uploaded by users but accuracy cannot be assessed by the assessor as access is not publicly given.*
- **Precision:**  
*Codes are being uploaded by users but precision cannot be assessed by the assessor as access is not publicly given.*
- **Validity:**  
*The codes are expected to follow a unified national standard.*
- **Transparency/Integrity:**  
*Information is provided on the developers of the solution as well as Ideation, Consultation, Development and Deployment Processes, which means that there is a detailed information on the data source and methodology*
- **Completeness:**  
*Only limited number of actual solutions, so far covering only a small number of cities.*
- **Timeliness:**  
*The generation date of the published solutions is unknown.*



### Accessibility

- **Open data:**  
*Since codes rather than datasets are published on the platform, the Open Data criterion is categorized as N/A. However, the codes are open-source and free of charge without any licensing or subscription fees.*
- **Registration Requirements:**  
*No registration required and no fees or subscriptions to view urban solutions. For the "Know more" section, as well as accessing the codes users are required to register/login.*
- **Format Diversity:**  
*Since datasets are not published on the platform, the metric for Format Diversity is categorized as N/A.*
- **Format Accessibility:**  
*Since datasets are not published on the platform, the metric for Format Accessibility is categorized as N/A.*
- **Guidance/Documentation:**  
*Although there is a manual available on OpenForge, directed via link, there are no general manuals or guidelines on using the SmartCode platform. However, each solution includes a guidance on how to use it.*
- **Storability:**  
*Since datasets are not published on the platform, the metric for Storability is categorized as N/A.*



### Usability

- **Performance:**  
*Low First Input Delay (FID) which quantifies the experience users feel when trying to interact with unresponsive pages.*
- **Multi-channel Access:**  
*User experience is consistent across PC, phone and tablet.*
- **Inclusion:**  
*The platform complies with GIGW guidelines. The platform does not offer language options other than English.*
- **Intuitivity:**  
*The platform is intuitive to use through navigation to view the solutions under Explore Solutions.*
- **Interactivity:**  
*The platform provides solutions that users can utilise and adapt, however due to its purpose, it does not provide dashboards or interactive visualisations.*
- **Storytelling:**  
*Use cases are visually demonstrated in Solutions section with objectives and benefits of the use case as well as screenshots of the final product.*



### Challenges

- The digital solutions may need to be integrated well with existing systems and processes, which can be a complex and time-consuming process.
- The implementation of digital solutions may require robust and reliable digital infrastructure, which may not be available in all cities.



### Opportunities

- The platform provides actual digital solutions that can be used by cities to solve real life urban development problems as well as technical guidance and support for implementing digital solutions in urban areas.
- The platform acts as online community channel for urban planners, policy makers and stakeholders to share ideas and collaborate on urban planning and development issues in India.

SmartCode

	KPI ID	KPI				
<p>QUALITY</p>	Q1	Accuracy	Q1	N/A		
	Q2	Precision	Q2	N/A		
	Q3	Validity	Q3			
	Q4	Transparency / Integrity	Q4			
	Q5	Completeness	Q5			
	Q6	Timeliness	Q6	N/A		
<p>ACCESSIBILITY</p>	A1	Open Data	A1	N/A		
	A2	Registration Requirements	A2			
	A3	Format Diversity	A3	N/A		
	A4	Format Accessibility	A4	N/A		
	A5	Guidance / Documentation	A5			
	A6	Storability	A6	N/A		
<p>USABILITY</p>	U1	Performance	U1			
	U2	Multi-channel Access	U2			
	U3	Inclusion	U3			
	U4	Intuitivity	U4			
	U5	Interactivity	U5	N/A		
	U6	Stroytelling	U6			
				Business as Usual	Stretch	Pioneering

Quality

- Codes follow a unified national standard and therefore can be trusted and used by a diversity of users in various contexts.
- Although a limited number of use cases, SmartCode offers detailed information on who developed the code/solution and how it was created.
- Detailed information is also provided on the Ideation, Consultation, Development and Deployment Processes.

Accessibility

- SmartCode is an access-based platform targeted at 'tech-savvy' actors, developers and coders, not the wider public. Therefore access is limited and it scores lower in this category.

Usability

- The platform is intuitive to use through navigation to view and explore solutions under the Explore Solutions functionality.
- Use cases and examples are offered for replicability and adaptability by different users, with screenshots of final products.
- SmartCode does not provide interactive dashboards or visualisations.

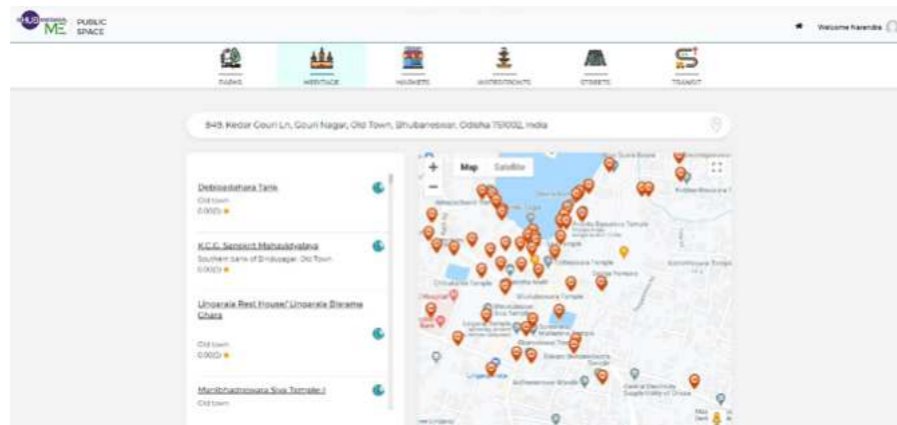
## SmartCode

### Use case

The Open Smart Code repository aggregates various source codes from developers across India who are focused on serving the software development demands of cities by creating urban applications. This is how the CITYPOINTS app was developed in Bhubaneswar Smart City (NIUA, 2021). The developing team utilised codes sourced from SmartCode to create a digital design and assessment tool for public spaces that integrates measurable aspects to enable citizens rate public spaces. The city administration was then able to map public spaces and undertake practical interventions based on safety, comfort, access, cleanliness and other aspects. The tool was then integrated with the Bhubaneswar.Me app (NIUA,2021).



Caption: SmartCode offices; Source: NIUA. (2021). SmartCode [online]. Retrieved from <https://smartnet.niua.org/smartcode/> [Accessed 2022].



Caption: Analytics from the Bhubaneswar Smart City app; Source: NIUA. (2021). SmartCode [Website]. Retrieved from <https://smartnet.niua.org/smartcode/> [Accessed 2022].

The app was developed in consultation with experts and citizens through participatory design workshops.

SmartCode allowed the developing team to use codes provided on the platform, and then share with others new codes that were created throughout the app development process (NIUA, 2021).



Caption: Pictures from the participatory design workshops; Source: NIUA. (2021). SmartCode [online]. Retrieved from <https://smartnet.niua.org/smartcode/> [Accessed 2022].





### 3.3 Platform Assessment Summary

This section summarizes the findings of the assessment of the five national Urban Data Platforms that are the focus of this study. It highlights the main strengths, weaknesses as well as interdependencies and complementarities between the five platforms.

#### 3.3.1 Overall performance



#### Quality

##### Data sharing platforms

Regarding the platforms that are aimed at data sharing (rather than analytics), SCODP and IUDX have slightly differing performances when it comes to data quality, although both score relatively high. It is important to note that although both platforms have similar purposes, IUDX access is closed to the public with a focus on Data Exchange.

In terms of data completeness, datasets on SCODP currently cover more cities than on IUDX. On SCODP the 100 Smart Cities are covered including for example Ahmedabad, Bangalore, Chennai, while only 35 cities are covered on IUDX, and only 132 datasets are available publicly for onboarded cities. It is understood that SCODP is aimed at a wider audience and provides data to the general public and a diversity of users (Open Data), while IUDX focuses on a smaller number of cities and offers more specialised and specific data (Data Exchange).

Nevertheless, both platforms follow a rigorous data validation process. As data is uploaded by cities themselves on both platforms, the platform providers must ensure that uploaded datasets are easy to use by anyone or any city department. Open Data is validated by CDOs and DAMU at the national level before publishing on SCODP, using defined standards. On IUDX, the datasets adhere to national standards and guidelines such as the National Data Sharing and Accessibility Policy. Therefore, users can be reassured that data found on both platforms is accurate and has been validated. This means that data can be trusted when used for other purposes.

Further, datasets have a high level of detail on SCODP - metadata, source and year are defined for each dataset. As datasets are submitted by cities themselves, the level of transparency on both platforms is high and represent actual city data. Although the data generation date can be known on IUDX, it is not directly visible on the platform for all cases. However, for SCODP, the level of frequency is defined for each dataset while uploading it. This can be monthly, semi-annually, annually, or other. The functionality to update data is existent on the platform, but the frequency depends on each city and differs from city to city. This means different data is available for each city and in some cases leads to a lack of universality.

##### Data analytics platforms

On the platforms that provide data analytics, insights and visualisation, AMPLIFI is still in its beta version with the intent, however, to be updated annually. For IUO, the generation date is known and current enough at the time of publication. However, it could be argued that it is not updated frequently enough to influence the appropriate level of decision-making.

Data sources and metadata is available once logged in on AMPLIFI. Data comes from the cities themselves, so the level of detail and transparency of dashboards and analytics is high on both platforms. This is important so that users can be confident in the analysis they receive and may be inspired to replicate this within their own context after observing the level of insight the platform can offer. On IUO, data comes from a number of public sources many available on IUDX and SCODP, too. Other input comes from government data sources, such as, amongst others, the GSI portal, Bhuvan or data.gov.in, and third party data sources (e.g. live traffic data from Uber or Google and crowdsourced data from public apps like STRAVA or remote city sensor data like from Landsat). Although mostly only the publisher's name is available as a reference of data source and there is no other specific detailed information, this is considered sufficient since IUO was designed as a phygital data lab. Indeed, its focus is on the creation of specific use cases from data sourced and uploaded by agencies and organizations that were themselves screened and validated on SCODP and IUDX. Further, the availability of analytics from live data is considerable and a rich source of information for cities.

No platform covers all cities - AMPLIFI e.g. focuses on the 100 Smart Cities plus a selected number of additional cities, depending on the data category. Although dashboards have been prepared at the global, state, national and city level, only a limited number of cities are covered on IUO, and content for major sectors is still missing. The purpose of those platforms is to provide insights through the use of use cases which can be replicated across cities. Therefore, the replicability and variety of content, as well as the number of urban sectors themselves covered is more essential than the number of cities covered. Additionally, destined for the 100 Smart Cities, AMPLIFI provides more specialised and characteristic data.

##### SmartCode

Finally, SmartCode is categorised differently to other platforms as a repository for developing software and applications for cities. Further access is restricted, so therefore the accuracy and precision of data is not qualifiable. Codes, however, are expected to follow a unified national standard, and therefore can be trusted and used by a diversity of users in various contexts. Further, although there is only a limited number of actual solutions and practical examples, SmartCode offers largely detailed information on data source, i.e. who created the code and solution, and how it was created. Detailed information is also provided on the Ideation, Consultation, Development and Deployment Processes. This is crucial as it enables the code to be replicated in different contexts and encourages engagement between the user and the developer, either to enquire more detail or discuss how it can be applied to a specific place in practice.



## Accessibility

### Data sharing platforms

Accessibility evidently differs between SCODP and IUDX as one is open access (per its name and purpose, although access is required to use APIs) and the other is access based and deals with more sensitive data. However, this does not mean that they work in opposition, they merely cater to different target groups. On the contrary, those two platforms complement each other. The 100 Smart Cities have access to both open data on SCODP and more specific sensitive data through IUDX. IUDX could, however, support SCODP and the open data use cases it offers further by making its access public. Partly such public data provision is happening also from IUDX already.

SCODP also provides further opportunity to link available data with wider datasets, through non-proprietary open formats, URIs and links to other data. This enriches the information offered on the platforms and provides opportunity for the user to widen the scope of the data required.

Data on SCODP is available in three or more machine-readable formats which is crucial in terms of inclusivity to allow a wide range of users with different requirements and different levels of digital literacy to use and view data. This also encourages wider collaboration and engagement with citizens, organizations and stakeholders in different departments, who may not have access to data-friendly tools per se. Format diversity and format accessibility are both highly important, especially to allow platforms to communicate with each other. Both platforms offer API formats which is crucial in providing a standard and automatic way of accessing data and which is in turn essential for scaling-up and replication purposes across different applications and cities.

Finally, both platforms display a large set of guidance and documentation, such as guidelines and manuals, resources templates and metadata on how to use the platforms and data, as well as contact details for support and help. This could be further complemented with guidelines reflecting the links between SCODP and IUDX, how they interact with each other and where opportunities lie.

### Data analytics platforms

Both - IUO and AMPLIFI - provide a high level of format diversity. IUO offers three or more machine-readable formats of data insights as a drop-down menu, including SHP, KML, XLS. Similarly, AMPLIFI also provides machine-readable formats. This is noteworthy as it allows cities at different digitalisation development stages to still assess their performance in comparison to others on AMPLIFI, or just to view what type of insights data digitalisation provides. As those platforms are not data aggregator platforms, but rather data visualisation tools, format accessibility is not crucial. Downloading data is not necessary, especially when a considerable amount of viewing formats is available. Nevertheless, some datasets on IUO are available to download, as well as enabling users to interact with and use the features of the platform, such as creating their own web-based maps. This provides a level of interactivity with the platform. AMPLIFI does not provide interactive map creation, however, it allows cities to test various variables and scenarios, and examine how their performance compares to other cities and regions.

Finally, both platforms provide metadata and user manuals on using the platform.

### SmartCode

Again, accessibility on SmartCode is limited, hence why the platform scores low in this category. The platform is targeted at 'tech-savvy' actors, developers and coders. It is not destined to be accessed by the public or non-technical city stakeholders. However, there is a potential to link SmartCode with visualisation platforms, such as IUO, so that solutions that were developed using the platform can be visualised alongside other insights and use cases, and further linkages and collaboration opportunities may arise.



## Usability

### Data sharing platforms

In terms of usability, both SCODP and IUDX score high. Responsiveness and visual stability of the websites are good, which is important to increase engagement and interaction. Further, the user experience is consistent on both platforms, across different access points. This is important, especially if a user goes from one platform to the other. It makes cross-collaboration easier, and allows the user to use the platforms on different devices, which is practical when engaging stakeholders with varying access to technology. Both platforms are intuitive to use, data can be searched and found in similar ways. Again, this consistency enables interlinkages between the platforms, and in the future, could make the transition to a combined platform easier. Data can be found and categorised by geography and sector, allowing the user to also compare how their city is performing in terms of data quality and accessibility compared to the others.

Interactivity on both platforms is limited. However, IUDX provides use cases which allow visualisation on how data can be used and what for, and types of collaboration it can engender as well.

### Data analytics platforms

Usability on IUO and AMPLIFI is crucial as those platforms are destined to be interactive and user friendly. Both of them score and perform well in this domain. Both platforms are intuitive to use, and have varying levels of interactivity. Both provide interactive dashboards which allow the users to test different data scenarios and compare different city performances. Moreover, they are visually pleasing and display live analysis. Additionally, IUO provides storyboards and use cases. What would take those insights even further would be to allow the user to select data directly available on IUDX or SCODP to visualise on those platforms. Direct links between the data sharing and data analytics platforms could be created and made transparent so that users can make direct connections between both. Creating interactive dashboards and visualisation tools on those platforms to view data available on SCODP or IUDX would help in decision-making and perhaps make data more accessible and easier to understand, contrary to the formats currently available on SCODP and IUDX. This would further encourage more cities to engage with and participate in those platforms.

### SmartCode

Despite SmartCode being designed for a specific and more technical target group of actors, the platform is intuitive to use through navigation to view and explore solutions under the Explore Solutions functionality. The platform provides solutions that users can easily utilise and adapt according to their context. It does not offer dashboards or interactive visualisations, due to its purpose but use cases as well as screenshots of final products are available to users.



## 4 Results

### 4.1 Opportunities and Challenges

The following chapter considers the opportunities and challenges identified from the policy review, interviews, and the platforms' assessment. Opportunities are significant for future Good Practice in other contexts or for leveraging potential. Challenges impede platforms in meeting their full potential.

#### 4.1.1 Opportunities

##### Data Platforms are also Knowledge and Learning Platforms

Many existing cities (especially among the 100 Smart Cities) have already excellent competencies in digitalisation. Platforms are tools to capitalise on this knowledge. The use of platforms enables increasing knowledge transfer and sharing between cities. Platforms encourage cross-sectoral and cross-cities collaboration. For example, the SmartCode Platform enables cities to reuse codes and applications developed by other cities for tackling urban challenges, supporting them in their digital transition for urban development. This is especially helpful to smaller municipalities who may have limited capacities. Use cases help in educating those smaller cities about problem statement and solution creation for future development. Platforms allow city representatives and their City Data Officers to showcase and demonstrate use cases, which can then be shared on social media for further promotion and replication especially amongst smaller municipalities. The Indian Urban Observatory is an example of a highly visual platform for demonstrating these use cases interactively.

##### Data Platforms encourage collaboration with Civil Stakeholders:

In addition to the facilitation of increased collaboration between cities in India, platforms are being used as tools to collaborate with external institutions or partners. Partnerships and cross-learning have emerged with international organizations (such as the World Bank or the World Economic Forum and Open Government Partnership with the SCODP). Collaborations have been started with research institutes (such the National Institute of Urban Affairs, the Indian Institute of Technology Delhi, the Indian Institute of Management Ahmedabad), which use data shared for further analysis and evaluation on the city's performance, and conversely provide insights to cities on areas for improvement.

##### Direct Impact on Efficient Governance in Smart Cities

The availability of Urban Data Platforms helps in making governance processes and systems more efficient, as mentioned in the interviews. The use of technology is an enabler for more efficient governance. Interview participants experienced that digitalising urban services leads to less bureaucracy as there is an easier flow between departments. It also helps in letting citizens know of their rights. Platforms encourage a systemic and strategic approach to data management. They help in streamlining urban development within different departments. Data shared through the Control and Command Centres help assessing how the city is performing, identifying daily issues (such as traffic management or air quality, for example, but also tracking responses to citizens' complaints or the financial performance of cities based on tax revenue collection) and quickly linking the correct corresponding operating procedures within the city. More practically, the development of platforms leads to the standardisation of legislation across the country, leading to a consistent urban development agenda.

##### Solid Basis for Scaling

The Indian Government has chosen an approach where it developed and launched five different platforms over a short period of time (less than three years). This led to collaborations and partnerships, established workflows for data collection and processing, but also enabled real-life testing of different solutions and options to utilise data for urban development. This learning-by-doing approach provides thus a solid basis for the national government of India to explore which platforms have best worked for which context in practice and what opportunities each platform offers, which in turn helps in choosing which options should be scaled and pursued further effectively.

### 4.1.2 Challenges

Challenges are related either to the capacity of users to use the platforms, or to the platforms themselves and what they provide.

#### Linked to the capacity of users:

#### Uncertainty

As interview participants from the national level noted, some confusion was observed amongst city stakeholders about the platform purposes because of difficulties in understanding the differences between the five nationally provided Urban Data Platforms – but also other platforms beyond the Smart Cities Mission that existed before or have emerged in parallel. Stakeholders do not always understand the functionalities of each platform and the datasets that are provided, limiting their capacity to participate.

#### Disparities in Digitalisation

Disparities regarding digitalisation were also recognised as challenges to using Urban Data Platforms during interviews. The digital divide is a recognised challenge in India and spans not only internet availability, but also access to electricity, computers, and smartphones among others (Oxfam India, 2022). Only 31 percent of the rural population uses the Internet compared to 67 percent of their urban counterparts, according to India Inequality Report 2022: Digital Divide (Oxfam India, 2022). Limited digital literacy amongst smaller ULBs impede their integration within the ecosystem. Indeed, digitalising data requires financial and skills capacity - much of the data is still only available on paper format. Some experts show some hesitation towards using technology, as old ways feel more familiar and comfortable. There is a need for behavioural change towards digitalisation. City Data Officers (CDOs) change relatively often at the local level, according to interview participants, meaning they lack the initial training and induction delivered from national government when the 100 smart cities were initially identified. This highlights the need of robust knowledge management and transfer at the city level. Although regular and focused capacity building is being delivered at the national level and a CDO handbook has also been released to enable CDOs understand their role better, support costs are needed to onboard new stakeholders at the local level.

#### Linked to the platforms:

#### Platform and Data Gaps

There are also concerns about limited or missing functionalities of platforms, impeding their use. Although platforms comply with national guidelines, they could also follow international accessibility guidelines. Regarding the data itself, missing or incomplete data is a particular challenge. While the different platforms have their own established processes and standards, there is not, as of yet, a unified data validation system or standardisation process coordinated at the national level that ensures a consistent data collection and publishing process, which is important when data originates from different stakeholders. Indeed, data cleaning and processing is undertaken by CDOs, and standard guidelines are offered and should be followed for each of the platforms, such as the NDSAP guidelines, but there is no overarching standardisation regulation or law established. Further, data automation is not yet established which means, coupled with missing new sourcing of data altogether, much of the datasets are not updated regularly. Getting quality and usable data is the main challenge today for the development and management of those platforms. So far, often cities are publishing data through the portal, but not necessarily using it. Although data is available (if open access), it is not always usable.

#### Platform and Data Accessibility

The first platforms developed (SCODP, SmartCode and IUO) have a focus on open data, the later platforms (IUDX and AMPLIFI) provide more focused, secure and user-centric data exchange. In the future, there is a will to move towards data marketplaces and the monetisation of data (Samuel and Gupta, 2022). While this brings lots of potential and opportunities regarding the sustainability of the platforms as well as the quality and value of the data and digital solutions, it is a challenge to balance between the different interests.

## 4.2 Recommendations

Following the discussed opportunities and challenges, this study concludes with recommendations. The data-driven urban development in India is at a crossroads, moving from a phase of implementation with a focus on the 100 Smart Cities towards a phase of scaling and rolling out solutions. Therefore, there is a range of different options of development as shown in figure 13. Considering the limitations of the study scope, these recommendations need to be understood as options and scenarios that will need further investigation and the development of a concrete strategy.

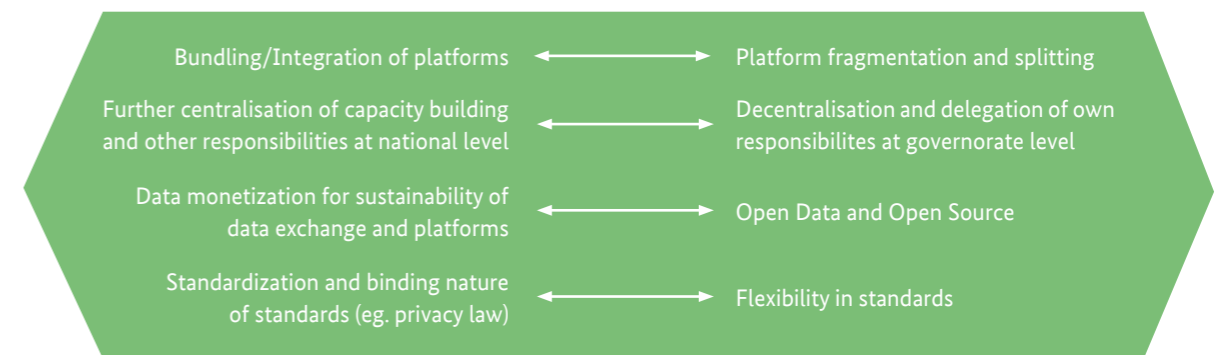


Figure 13: Overview of recommendations (Buro Happold, 2023)

Our recommendations based on the study are detailed below.

### 4.2.1 Integration of platforms

**Overview:**

India provides a variety of platforms with different purposes and roles. However, those platforms also display some level of replication. Smart-Code can be interpreted as the engine, SCODP and IUDEX as their inputs and IUO and AMPLIFI as the outputs. Linking those platforms further together could capitalise on and even strengthen each of their benefits and assets, and enable their complementarity.

Linking the different platforms together would establish a level of transparency of data being assessed and evaluated on visualisation platforms, and provide options for users to download data themselves for further analysis if they wish. Automatising the linkages between them would mean that visualisation platforms would have access to a wide array of data available. Insights would be deepened and strengthened, and be created for a larger number of cities.

**Key stakeholder(s):**

National government

**Beneficiary/ies:**

Data and analytics providers (i.e. cities, private sector, academic and research institutions)

**Enabling factors:**

- Coordination amongst platform providers

**Challenges addressed:**

- Missing data on certain platforms
- Duplication of efforts
- Efforts of coordination amongst data platform providers



**Improvement suggestions:**

- Creating automation processes between data analytics, data exchange and coding platforms
- Create a roadmap and workflow for data processing, with stakeholder mapping
- Standardise data quality and accessibility requirements between platforms



**Opportunities:**

- Efficient use of time and financial resources
- Availability and access to more data sets
- Automating data insights and visualisations
- Increased opportunities for actors that analyse data and provide insights (mostly private sector and academic institutions) to engage and collaborate with dataset providers (cities and municipalities)



**Risks:**

- Differing agendas and varying priorities from data platform providers
- Reduced focus on specific user groups

### 4.2.2 Decentralisation of capacity building

**Overview:**

There is a general need for more workforce, especially at the local level. CDOs alone struggle to manage the entire data ecosystem at the local level, to coordinate their teams and the collection and processing of data, to create use cases and partnerships with the private sector and much more. CDO roles need to be implemented all over India. Further, staff at different levels need to be trained accordingly, especially within Command-and-Control Centres. National support is required at the local level to stakeholders across different departments (other than CDOs), both to explain the significance of data for urban development and begin a process of behavioural change towards digitalisation of urban development. However, as the numbers of participating cities increase, decentralisation of capacity building needs to be considered, for instance through a bigger role of state governments, as well as horizontal capacity building between cities. Training and support could be provided in the form of hackathons, easy-to-use toolkits, and even more tailored one-to-one meetings with CDOs.

**Key stakeholder(s):**

National government with CDOs, cities governments (CDOs) with their colleagues internally, state governments

**Beneficiary/ies:**

Cities stakeholders

**Enabling factors:**

- Investment and funding from government
- Time resources
- Learning material and easy how-to guides and toolkits
- Hackathons and interactive workshops
- One-to-one meetings with CDOs
- Collaboration with state governments

**Challenges addressed:**

- Reticence towards digital transition
- Confusion and lack of understanding around functionalities of platforms and importance of digitalisation
- Missing or incomplete data
- Lack of data digitisation due to hesitation in using technology
- Reticence to participate and digitalise due to financial constraints
- Restrictions to data access
- Sustainability and self-sufficiency of the platforms beyond public funding



**Improvement suggestions:**

- Regular tailored hackathons and interactive workshops inviting a diversity of stakeholders from different departments, sectors and disciplines (both within cities and private and third sectors)
- Develop use cases and Good Practice that could be replicated
- Possible decentralisation of capacity building through support from state governments



**Opportunities:**

- Skilled workforce
- More involved, engaged and higher participation
- Behavioural change towards digital transition
- Digitised data and datasets
- Knowledge share and cross-learning



**Risks:**

- Time and financial resources required
- Fragmentation of standards and processes

### 4.2.3 Data monetisation vs Open Data and Open Source

**Overview:**

The next planned phase for the development of national Urban Data Platforms includes data monetisation. While there are recent studies exploring and defining the potential and possible business models for data monetisation (Samuel and Gupta, 2022), guides and a clear road-map towards a data marketplace by national government should be offered to cities and other stakeholders on national and state level to support them in monetising the data they provide. Platforms could be used as a means to sell and buy data. The Ministry of Road Transport and Highways has tested selling anonymised vehicle and registration data to public and private sector banks, logistics solution providers, insurance organizations, automobile manufacturers and others, who then used it to further develop their service offer. Another pathway could be through membership programmes. To access platforms, users need a membership. With this membership, users could buy and share data and/or codes (such as on the SmartCode Platform), which they could then reuse for their own purposes and applications. Finally, platforms could become a marketing tool for the private sector to showcase the apps and other urban solutions they can produce and create.

However, considerations to make all data open and accessible to all three levels (national, state and local) without the need for registration is also highlighted as an important step to enable the ecosystem to thrive. Those two aspirations are somewhat conflicting. One alternative is to limit monetisation according to the purpose of use, for instance to monetise the analytics that are being produced from the use of open data. Urban Data Platforms could therefore still provide data to everyone that is open, but any assessment or insight of the data could be monetised through billing and charging for instance.

**Key stakeholder(s):**

Platform providers and developers (i.e. national government)

**Beneficiary/ies:**

Data and analytics providers (i.e. cities, private sector, academic and research institutions)

**Enabling factors:**

- Further research into costing/business models
- Financial investment
- Partnerships with platform developers/start-ups

**Challenges addressed:**

- Reluctance to participate and digitalise due to financial constraints
- Restrictions to data access
- Sustainability and self-sufficiency of the platforms beyond public funding



**Improvement suggestions:**

- Market analysis to question what types of data could first be monetised to cross-subsidise the model
- Licensing of data
- Clear pathway/roadmap towards a data marketplace with detailed targets and milestones



**Opportunities:**

- Making platforms self-sufficient
- Data access and inclusivity
- Wider participation as no restrictions to access and financial incentive
- Raising awareness on the economic potential of data
- Revenue resource for cities



**Risks:**

- Conflicting interests between monetised and open data
- Concerns around the privatisation of platforms
- Restrictions on data access if monetised

### 4.2.4 Standardisation and binding nature of standards

**Overview:**

Providing more robust and regular frameworks and regulation on privacy and security of data at the national level is key, not least for dealing with local scepticism and encourage further participation locally, too. It is important to note that data standardisation is currently being developed under the NDSAP policy. Further, clear regulatory policies and certifications on data standardisation are needed and must be implemented defining rules on ownership, licensing, formatting, access, archiving, data cleaning, quality assessing and publishing. While there are many efforts regarding data security and quality, there is potential for addressing data privacy in a more holistic and binding way. It is important to note that a binding Privacy Law is being developed but was not officially ratified before the completion of this study.

**Key stakeholder(s):**

National government

**Beneficiary/ies:**

CDOs who process data, but all data collectors and publishers

**Enabling factors:**

- National data standardisation, privacy and security regulations and policies
- Capacity-building and workshopping around data standardisation process

**Challenges addressed:**

- Poor data quality
- Limits to data access
- Time and effort resources required for data cleaning and processing by cities
- Scepticism to participate



**Improvement suggestions:**

- Clear and robust frameworks and regulations
- Detailed action plans and step-by-step guidance on data standardisation
- Streamlining data standards across different initiatives
- Rating functionality on platforms to score data quality
- Automation of data standardisation and processing



**Opportunities:**

- Streamlined process to publishing data
- Higher quality, accessibility and secure data
- Less resources spent on data cleaning, processing and updating at the city level
- More participation to collect and publish data



**Risks:**

- Bureaucratic and political inconsistencies or pushbacks to implement regulations
- Financial commitment from national government to roll-out regulatory frameworks
- Time commitment from national government to define evidence-based standards

#### 4.2.5 Rollout of data collection architecture

**Overview:**

Not all cities have the capacity today for efficient data collection. Investment into innovative data collection instruments, such as sensors or GPS-based tools, or into partnerships with companies specialised into data collection would overcome this limitation. Those instruments also ensure real-time up-to-date data, which would reduce the need to manually update each dataset.

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**Key stakeholder(s):**

Cities governments

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**Beneficiary/ies:**

Data and platform users, policy research

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**Enabling factors:**

- Partnerships with the private sector to roll-out new technologies in cities
- National investment and funding to install new data architecture throughout the cities

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**Challenges addressed:**

- Data is outdated and inaccurate
- Time, skills and financial resources needed to manually collect data
- Reticence towards a digital transition due to limited digital literacy
- Bureaucracy



**Improvement suggestions:**

- Installation of sensors and GPS-based tools where applicable and with proportionate benefit



**Opportunities:**

- Machine-readable datasets
- Real-time data
- Digitised data and datasets
- Streamlined processes
- No need for manual data updates
- Skills development and capacity-building can focus on data analytics rather than data collection
- Data insights use accurate real-time data and are created automatically



**Risks:**

- High cost
- New tools may need regular maintenance
- Large amounts of data without proper analytics and insights

#### 4.2.6 Wider participation

**Overview:**

There is a need for wider participation, both internally within the public sector, encouraging the states, different departments and smaller municipalities to participate, but also externally with the private sector. To encourage wider engagement internally, especially with smaller municipalities, nationally-driven initiatives such as stricter regulation or 'policing' methods, like integrating within the financial system locally (taxing for instance) could be established. Local incentive mechanisms could also be implemented, such as challenge-driven programmes and competitions with prizes. Industry and private developers could benefit from the platforms as tools for advertisement and promotion of their work or app. Having more capacity though, private sector participation should be implemented through membership schemes to access the platform, its functionalities and the data it provides.

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**Key stakeholder(s):**

National government and cities government.

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**Beneficiary/ies:**

Platform users (city stakeholders from different urban departments, private sector and research institutions)

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**Enabling factors:**

- Incentivisation for the public sector, such as challenge-driven programmes and competitions organised by national government
- Incentivisation for the private sector, using platforms as means for advertising and promotion of their work
- Data monetization

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**Challenges addressed:**

- Smaller municipalities being left behind
- Lack of engagement with the private sector
- No accountability from national government on engagement



**Improvement suggestions:**

- Organise tailored competitions and challenges between cities, with IT departments
- Integrate scoring systems and tracking tools to competitions to measure performance and build accountability
- Integrate private sector apps and products into platforms
- Develop use cases and Good Practice that could be replicated
- Use existing cities as multipliers for Good Practice



**Opportunities:**

- Wider engagement and participation
- Cross-learning between cities and with the private sector
- Pathway to platform monetisation
- Partnerships with the private sector



**Risks:**

- Coordination and time capacity from national government. However, wider participation and more capacity in time from lower tiers of government may balance this initial investment from the national scale.

#### 4.2.7 National guidance and regulations

**Overview:**

Finally, more guidance and direction from national government is needed. Further documentation and a roadmap on the future of platforms, the leveraging and scaling-up plans for other cities would be good and help in identifying opportunities and future growth. This could build on the Maturity Assessment Framework, assessing the performance of existing cities, and suggesting future actions and next steps to take forward. A roadmap with clear timeframes, targets and KPIs would help cities in projecting themselves more and give them a goal towards which to aim.

---

**Key stakeholder(s):**

National government

---

**Beneficiary/ies:**

Platform users, especially cities governments (i.e. CDOs and their teams)

---

**Enabling factors:**

- Lessons learnt from the past five years to inform future
  - Research into future opportunities, such as economic opportunities, new technologies
- 

**Challenges addressed:**

- Scepticism and reticence from cities to participate
  - Lack of accountability from national government
  - Lack of coordination between different levels of governance
- 



**Improvement suggestions:**

- Roadmap with clear milestones, targets, KPIs and action plans for the next steps regarding Urban Data Platforms
- Identify which cities to target next, to help enrolled cities understand who to reach out to and support
- Propose different pathways for growth



**Opportunities:**

- Easier for cities to project themselves which might encourage them to engage and participate more
- Scaling-up opportunities
- Roadmap towards growth
- Coordinated approach



**Risks:**

- Requires planning and forward-thinking and consideration of unknown elements, meaning that respective guidelines need to demonstrate a certain level of flexibility.

#### 4.2.8 Further research requirements

To conclude, further research is required, especially around pathways towards monetisation. Lessons learned from other countries, contexts and environments could help in this respect. Working with specialised teams will be necessary to understand the economic potential of data and/or platform monetisation, different costing techniques and business models, as well as to evaluate the benefits and disadvantages in doing so. Consideration of integrating existing financial systems within the national government, such as the tax system or other financial levers, could also be explored.

Further, research could also be undertaken around incentivisation or sanctioning methods to Urban Data Platform participation. Today, the government of India put in place the Maturity Assessment Framework to assess the performance of cities. A mechanism that helps to hold governments accountable may bring favourable results. This could also encourage cities to be more engaged and participate more actively.

Finally, national government should focus investment using a needs-based approach, identifying immediate priorities based on identified challenges. A completed multi-criteria assessment of recommended next steps, identifying incurred preparation, development, implementation and operationalisation costs, impact, cross-benefits, unexpected consequences, timelines, enabling factors, targets and milestones would help with prioritising actions and thus investment.



## Appendices

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# 1 Good Practices

## CITY

### NYC Open Data [\(https://opendata.cityofnewyork.us/\)](https://opendata.cityofnewyork.us/)

#### OVERVIEW

##### Vision

Open Data Program is a civic problem-solving platform for all New Yorkers.

##### Mission

Open Data for all. It is an opportunity to engage New Yorkers in the information that is produced by City government.

##### General info

NYC Open Data is managed by the Open Data Team at the NYC Office of Technology and Innovation (OTI). The team works with City agencies and each City agency also has an Open Data Coordinator, who serves as the main point of contact for the Open Data team and the public, and works to identify, document, structure, and manage the agency's public datasets.

#### Responsible body: Local Government

Mayor's Office of Data Analytics and the Department of Information Technology and Communications, Open Data Team, NYC Office of Technology and Innovation (OTI)

#### User groups: Anyone/Public

Every New Yorker

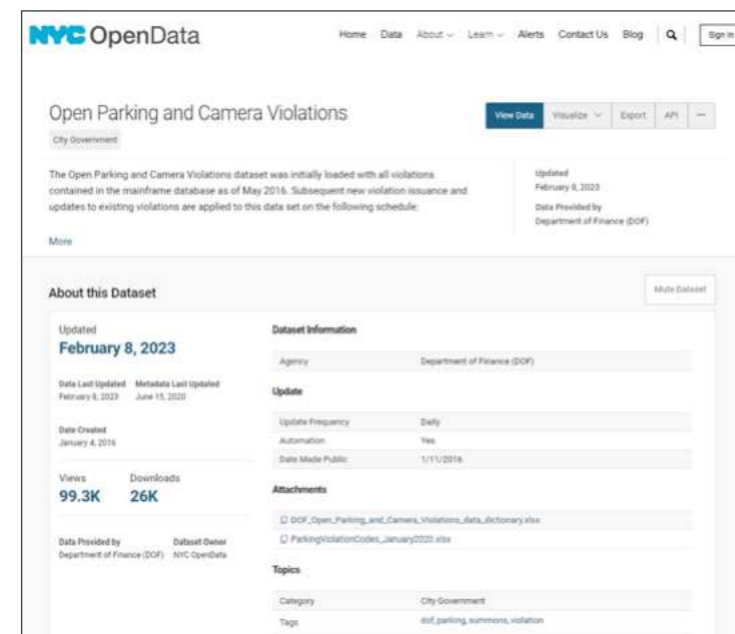
**Sectors:** Social/Demographic, Economics, Transport, Water, Waste, Informality, Tourism, Energy, Civic engagement, Business, City Government, Education, Environment, Health

#### Purpose: Data information, Collaboration and networking, Data repository

To identify and make data available, coordinate platform operations and improvements, and promote the use of Open Data both within government and throughout NYC

#### Partners and Collaborators:

Government agencies, academic institutions, non-profit organizations, and private companies



#### KEY FEATURES

- data completeness is ensured as required by law
- user-friendly interface for browsing and searching for data sets
- data sets are well documented, including descriptions, field definitions, and update schedules
- opportunities for data visualisation, analysis and storytelling.

### Berlin Open Data [\(https://daten.berlin.de/\)](https://daten.berlin.de/)

#### OVERVIEW

##### Vision

Berlin 2030: For the citizens and visitors of the city, it has become a matter of course that they have unrestricted access to all city data.

##### Mission

As an open data information point, our primary task is to be the contact for the Berlin administration for all questions relating to open data. We see ourselves as companions and supporters on an equal footing with the Berlin administration.

##### General info

In the Berlin data portal, the state of Berlin makes public administration data sets available. In this way, administrative employees, citizens, companies and scientists should be given the opportunity to access data and information from the Berlin administration via a central entry point and to use them further, so that new ideas as well as combination and analysis can be used to gain new insights from the existing data.

#### Responsible body: State Government

Senate Department for Economics, Technology and Research

**User groups:** Local Authorities/Municipalities/ULBs/City officials, State Authorities, Private urban professionals, Citizens, Universities/Educational Institutions

Berlin administrations, authorities, scientific institutions as well as citizens, media, companies and employers, science and research

**Sectors:** Social/Demographic, Environment, Health, Civic Engagement, Economics, Tourism, Transport

Labour Market, Demographics, Geography and Urban Planning, Health, Arts and Culture, Public Administration, Sports and Recreation, Environment and Climate, Traffic, Business, Housing and Real Estate, etc..

#### Purpose: Data information, Developing/Coding

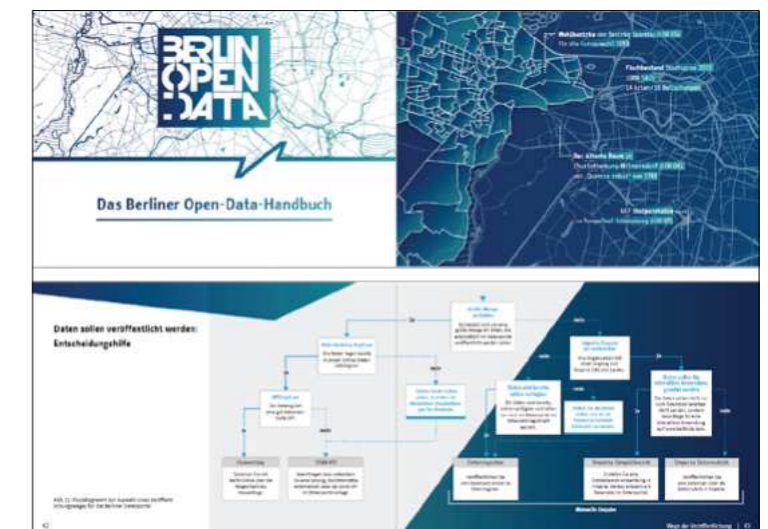
To give opportunity to stakeholders to access data and information from the Berlin administration via a central entry point and to use them further

#### Partners and Collaborators:

Government agencies, academic institutions, non-profit organizations, and private companies

#### KEY FEATURES

- good user guidance
- data is openly licensed, promoting the reuse and integration of data into new applications and services
- supporting transparency, accountability, and innovation by making city data accessible to the public and encouraging collaboration and knowledge-sharing among citizens, businesses and government.



**Helsinki Region Infoshare**  
[\(https://hri.fi/en\\_gb/\)](https://hri.fi/en_gb/)

**OVERVIEW**

**Vision**

To provide easy access to data and information from various sources in order to support decision-making, research, and innovation in the region.

**Mission**

Making public data available for citizens to access, use and transform into creative new mobile applications, to develop applications and follow public decision making.

**General info**

The Helsinki Region Infoshare (HRI) service aims to make regional information quickly and easily accessible to all. Essentially, HRI is a web service for fast and easy access to open data sources between the cities of Helsinki, Espoo, Vantaa and Kauniainen.

**Responsible body:** Local Government

City of Helsinki Executive Office; City Government of the cities of Espoo, Helsinki, Vantaa and Kauniainen

**User groups:** Anyone/Public

Citizens, businesses, universities, municipal administration, research and development, decision-making, data journalism and app development

**Sectors:** Social/Demographic, Economics, Transport, Water, Environment, Waste, Informality, Health, Tourism, Energy, Civic engagement, Education

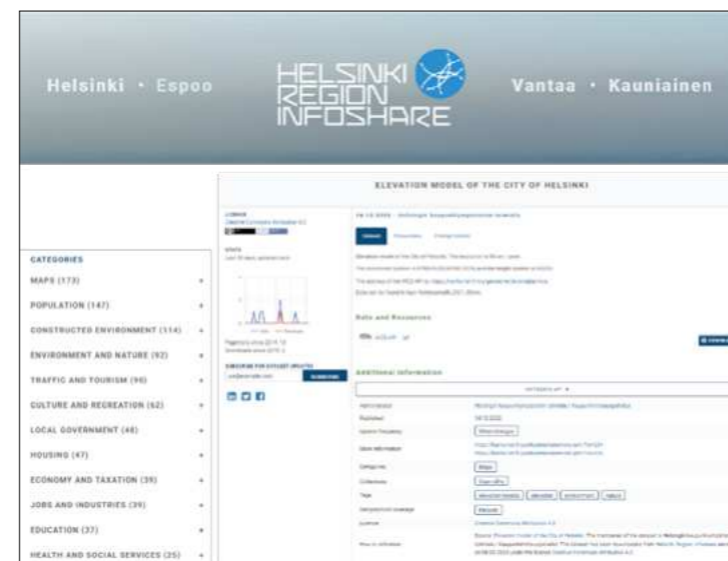
Housing, Local Government, Maps, Culture and Recreation, Traffic and Tourism, Education, Constructed Environment, Economy and Taxation, Health and Social Services, Jobs and Industries, Population, Environment and Nature

**Purpose:** Data information, Development

Making regional information quickly and accessible to all and enabling to develop transparency and create opportunity for private sector developers

**Partners and Collaborators:**

Government agencies, academic institutions, non-profit organizations, and private companies



**KEY FEATURES**

- change history is documented in detail and shows how data is updated daily
- wide range of data sets from various public sector organizations in the Helsinki region
- the availability of official language options for countries with high potential to use the shared data, including neighbouring countries.

**Transparenzportal Hamburg**  
[\(https://transparenz.hamburg.de/\)](https://transparenz.hamburg.de/)

**OVERVIEW**

**Vision**

Integrate your data and make life that little bit easier!

**Mission**

To ensure that the content you are looking for can be found easily, provides a full-text search for all data records.

**General info**

The transparency portal Hamburg is the information register required by the Hamburg Transparency Act (HmbTG), via which all information that is required to be published by law can be researched anonymously. It is the central access point to current data and information from the Hamburg administration.

**Responsible body:** State Government

Technical Control Centre Transparency Portal – Authority for Culture and Media – Office of the State Archive

**User groups:** Local Authorities/Municipalities/ULBs/City officials, State Authorities, Citizens, Universities/Educational Institutions

Non-commercial, scientific, and economic

**Sectors:** Social/Demographic, Transport, Health, Environment Weather Data, Geodata, Environmental Data, Traffic Information, Medical Research Results

**Purpose:** Data information

Provide current data and information from the Hamburg administration

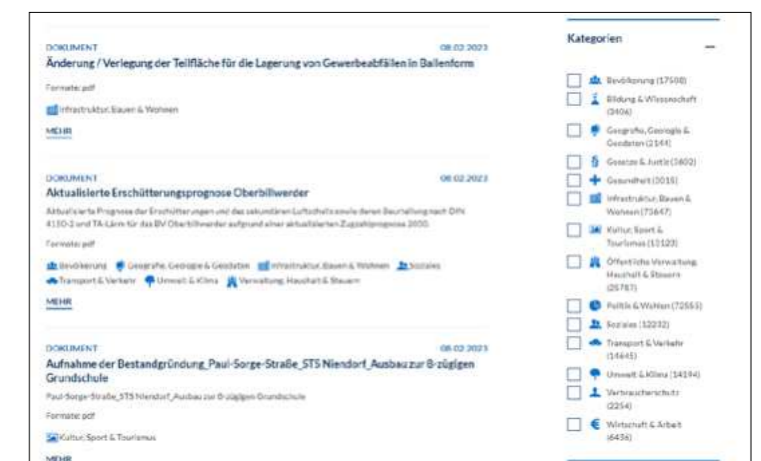
**Partners and Collaborators:**

Government agencies, academic institutions, non-profit organizations, and private companies

- Interactivity: Interactive website
- Storytelling: Visual demonstration

**KEY FEATURES**

- user-friendly interface for searching, browsing and downloading data
- supporting transparency and accountability by making public sector data accessible to citizens and businesses
- links to different data platforms
- the availability of different language options despite being city-wide.



CITY

Dubai Pulse

(<https://www.dubaipulse.gov.ae/>)

OVERVIEW

Vision

To be happiest city on Earth and to be completely paperless city, ensuring all government transactions are 100% digitized, saving 1,000,000 trees.

Mission

To become the smartest city in the world by harnessing digital innovation and to take its smart city transformation to a level such that digital transformation has a significant and positive impact on the city.

General info

Dubai Pulse is the means of sharing open data in order to be utilised by people and encourage the innovation among people.

Responsible body: Local Government

Dubai Statistics Centre – official source for the collection, analysis, publication, updating, maintenance and protection of statistical information, Government Entities

User groups: Anyone/Public

Participation from all city stakeholders – residents, visitors, business owners, parents and families

Sectors: Environment, Economics, Education, Health, Civic Engagement, Tourism, Transport, Social/Demographic, Energy

Animal, Environment, Business & Employment, Economics & Finance, Education, General, Government politics & Public Administration, Health, Sports, Utilities & Bill, Real-estate, Events, Social Service, Housing, Transport, Residency Visas, Tourism, Security

Purpose: Data information, Learning and development, Collaboration and networking

Creating value, improve quality of life and to improve citizens experience

Partners and Collaborators:

Government agencies, academic institutions, non-profit organizations, and private companies

ID	Item ID	Item Name	Category	Subcategory	Process	Process ID	Item ID	Item Name	Category	Subcategory	Process	Process ID	Item ID	Item Name	Category	Subcategory	Process	Process ID
1	1410	Grain	Wheat	Wheat	Wheat	Wheat	1410	Grain	Wheat	Wheat	Wheat	1410	1410	Grain	Wheat	Wheat	Wheat	1410
2	1410	Grain	Wheat	Wheat	Wheat	Wheat	1410	Grain	Wheat	Wheat	Wheat	1410	1410	Grain	Wheat	Wheat	Wheat	1410
3	1410	Grain	Wheat	Wheat	Wheat	Wheat	1410	Grain	Wheat	Wheat	Wheat	1410	1410	Grain	Wheat	Wheat	Wheat	1410
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18	1410	Grain	Wheat	Wheat	Wheat	Wheat	1410	Grain	Wheat	Wheat	Wheat	1410	1410	Grain	Wheat	Wheat	Wheat	1410
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21	1410	Grain	Wheat	Wheat	Wheat	Wheat	1410	Grain	Wheat	Wheat	Wheat	1410	1410	Grain	Wheat	Wheat	Wheat	1410

KEY FEATURES

- preview option and the visualisation tool
- providing a comprehensive view of various aspects of city life in Dubai
- the visual demonstration of use cases.

CITY

Open Data BCN

(<https://opendata-ajuntament.barcelona.cat/en/open-data-bcn>)

OVERVIEW

Vision

Promoting transparency in management, improving services to citizens, generation of business activities and social impact, seeking efficiency in governance.

Mission

To maximize available public resources, exposing the information generated or guarded by public bodies, allowing its access and use for the common good and for the benefit of anyone and any entity interested.

General info

Open Data BCN was one of the first comprehensive open data portals from a major European city, becoming renowned internationally and employing from the beginning visionary principles such as open data by default. Quality of datasets is exceptionally high, a total of 37 formats are available and datasets have been linked to the UN SDGs.

Responsible body: Local Government

Municipal Data Office

User groups: Anyone/Public

Companies, Administrations, Academia, Organizations, Communities and People

Sectors: Local Authorities/Municipalities/ULBs/City officials

Administration, City and Services, Economy and Business, Population, Territory

Purpose: Data information, Developing, Learning and development, Collaboration and networking

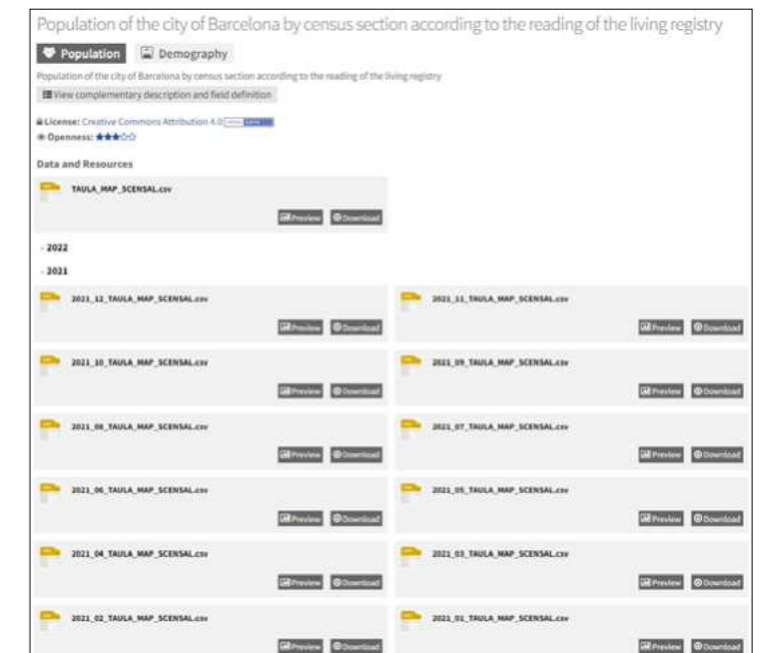
Promotion of transparency in management, support of internal efficiency in governance, improvement of citizen/visitor services, generation of business activities

Partners and Collaborators:

Government agencies, academic institutions, non-profit organizations, and private companies

KEY FEATURES

- Open Data BCN platform has a 5 star rating for datasets
- downloading the data in various formats and is available under open licenses
- adapting “The 2030 Agenda for Sustainable Development and Open Data BCN”
- language options in the official languages of the respective city and country
- internationally recognized standards for data quality
- providing tools and resources for data visualisation and analysis.



CITY

NATIONAL

**Gemeente Amsterdam Data Directorate**  
(<https://data.amsterdam.nl/>)

**OVERVIEW**

**Vision**

"The Amsterdam Data Platform ensures that all (open) data from and about the municipality of Amsterdam is secured, integrated, described, searchable and available in various appropriate services and product forms" (Gemeente Amsterdam Data Directorate, n.d.)

**Mission**

To create a municipal data foundation. Not only can the data be found in one place, but it is also securely accessible to users.

**General info**

The Data Platform makes a large part of the data management process accessible to both suppliers and customers, without the intervention of the Data Platform teams.

**Responsible body:** Local Government

Municipality of Amsterdam

**User groups:** Anyone/Public

**Sectors:** Waste, Environment, Tourism, Civic Engagement, Economy, Education, Social/Demographic, Transport

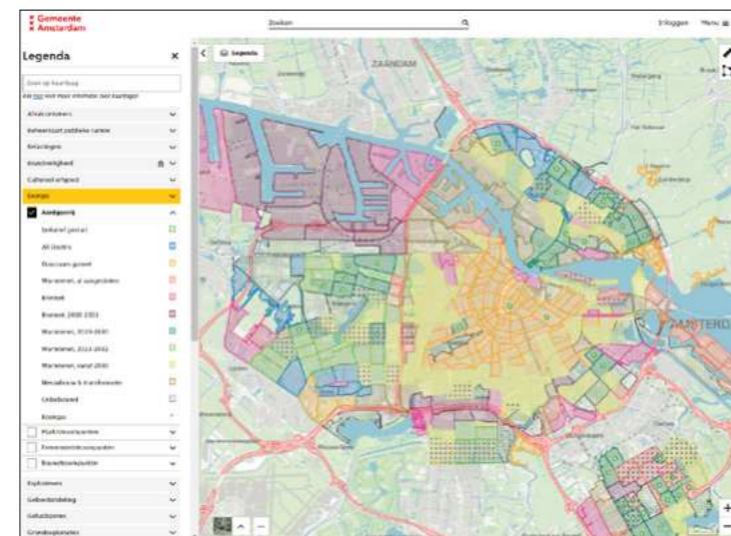
Management, Population, Culture and Recreation, Sustainability and Environment, Economy and Tourism, Education and Science, Public Order and Safety, Space and Topography, Traffic, Work and Social Security, Living, Care and Welfare

**Purpose:** Data information, Developing, Collaboration and networking

To support the development of data-driven working in all sectors of Amsterdam with one central location

**Partners and Collaborators:**

Government agencies, academic institutions, non-profit organizations, and private companies



**KEY FEATURES**

- A central Datahub which helps to have all data in one single place and facilitates coordinations amongst different stakeholders
- detailed map layers and tables on the interactive website
- accessing to a variety of data sources, tools for data analysis and visualisation
- careful recording and monitoring of access to sensitive data.

**Germany / GovData**  
(<https://www.govdata.de/>)

**OVERVIEW**

**Vision**

To promote transparency, efficiency, and innovation by making government data accessible, usable, and reusable to the public.

**Mission**

To find this data in one place and make it easier to use, to promote the use of open licenses and to increase the supply of machine-readable raw data

**General info**

GovData is an application of the IT Planning Council. The GovData office and coordination office, based in Hamburg, is responsible for the portal. The basis for the operation of GovData is set out in an administrative agreement. So far, the federal government and the states have joined the administrative agreement.

**Responsible body:** Centralised - National Government

IT Planning Council is responsible for the portal; SeitenBau GmbH is responsible for implementing the concept and hosting the portal

**User groups:** Local Authorities/Municipalities/ULBs/City officials, State Authorities, Private urban professionals, Citizens, Universities/Educational Institutions

Public bodies, administrative employees, citizens, companies, scientists

**Sectors:**

Energy, Health, Environment, Traffic, Economy and Finance, Region and Cities, International Issues, Science and Technology, etc.

**Purpose:** Data Information and repository

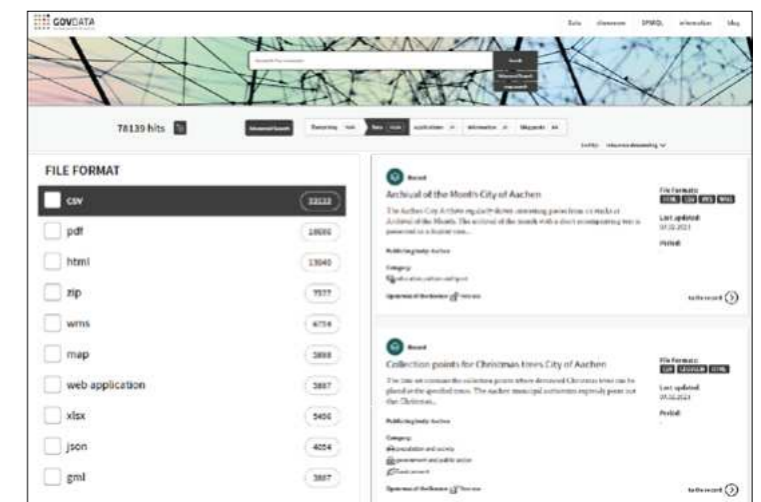
Uniform, central access to administrative data from the federal, state and local governments

**Partners and Collaborators:**

Government agencies, academic institutions, non-profit organizations, and private companies

**KEY FEATURES**

- open access to a wealth of government data and information
- the organization of community engagement events through Hackathons
- the availability of downloads in a variety of formats
- the provision of guidance and documentation through a variety of means such as guides, manuals, brochures, and posters
- provides a platform for public engagement and feedback, allowing citizens to participate in decision-making – citizens are able to input comments and ideas and have a voice in the shaping of public policy.



# NATIONAL

USA Data.gov  
[\(https://data.gov/\)](https://data.gov/)

## OVERVIEW

### Vision

To improve government mission achievement and increase the benefits to the Nation through improvement in the management, use, protection, dissemination, and generation of data in government decision-making and operations.

### Mission

To leverage the full value of Federal data for mission, service, and the public good by guiding the Federal Government in practicing ethical governance, conscious design and a learning culture.

### General info

The U.S. General Services Administration, Technology Transformation Service launched "Data.gov" in 2009, and the authorized body manages and hosts the website.

**Responsible body:** Centralised - National Government

U.S. General Services Administration, Technology Transformation Service

**User groups:** Anyone/Public

Citizens, businesses, universities, municipal administration, research and development, decision-making, data journalism and app development

**Sectors:** All

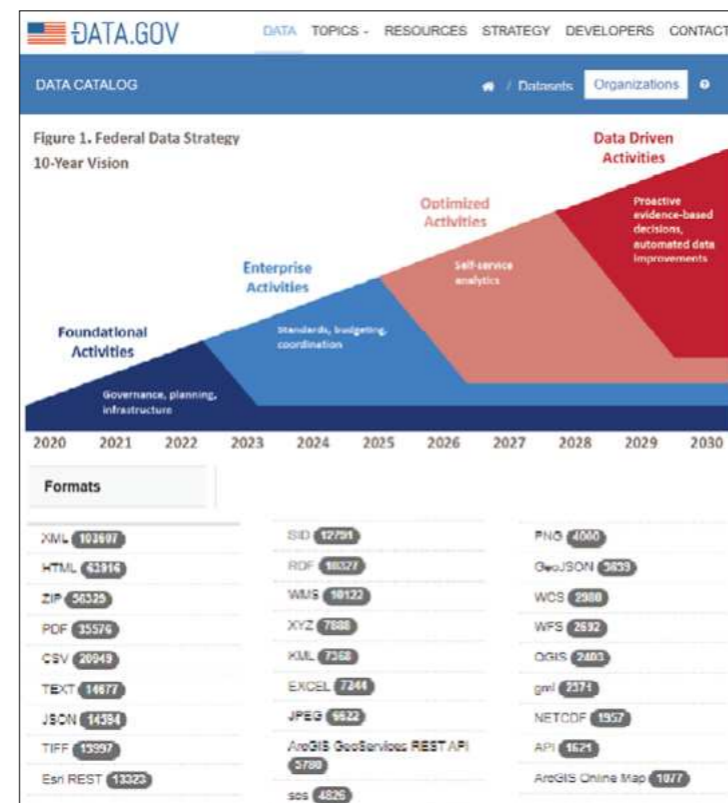
Social/ Demographic, Economics, Transport, Water, Waste, Informality, Tourism, Energy, Civic engagement, Business, City Government, Education, Environment, Health, Agriculture, Climate, Energy, Local Government, Maritime, Ocean, Older Adults Health

**Purpose:** Data information

Creating a Single Agency Data Inventory and Publish a Public Data Listing

**Partners and Collaborators:**

Government agencies, academic institutions, non-profit organizations, and private companies



## KEY FEATURES

- containing a vast array of data, covering various domains
- publicly available action plan and action progress
- a 10-year future plan
- providing the data in machine-readable formats, making it easier for developers to use the data in their applications; the visual demonstration and dashboards of use cases.

# NATIONAL

Singapore: Data.gov.sg  
[\(https://data.gov.sg/\)](https://data.gov.sg/)

## OVERVIEW

### Vision

"We are venturing into new industries, new technologies; globalisation is progressing, people talk about big data. We are part of that. We want to be a smart city, a smart nation." (Data.gov.sg, 2022).

### Mission

To make government data relevant and understandable to the public, through the active use of charts and articles.

### General info

Data.gov.sg was first launched in 2011 as the government's one-stop portal to its publicly-available datasets from 70 public agencies. To date, more than 100 apps have been created using the government's open data.

**Responsible body:** Decentralised - National Government to another public body

An initiative by the Ministry of Finance and is managed by the Government Technology Agency of Singapore

**User groups:** Anyone/Public

**Sectors:** Social/Demographic, Economics, Transport, Environment, Health, Civic Engagement, Education

Economy, Education, Environment, Finance, Health, Infrastructure, Society, Technology, Transport

**Purpose:** Data information, Developing, Learning and development, Collaboration and networking

Provide one-stop access to the government's publicly-available data; Communicate government data and analysis through visualisations and articles; Create value by catalysing application development: Facilitate analysis and research

**Partners and Collaborators:**

Government agencies, academic institutions, non-profit organizations, and private companies

## KEY FEATURES

- following an open data policy
- promoting transparency, accountability and innovation
- simple and intuitive interface that makes it easy to search, download and visualise data
- variety of datasets from different sectors such as transportation, health, finance, and more
- dashboard preview of the datasets and the visual demonstration of use cases.



# NATIONAL

## UK Data Service

<https://ukdataservice.ac.uk>

### OVERVIEW

#### Vision

“As the UK’s only nationally funded research infrastructure for curating and providing access to social science data, our practices, especially around data curation and secure access to data, have been influential across the world” (UK Data Service, 2022).

#### Mission

By improving the ability to extract knowledge and insights from complex collections of digital data, researchers help to accelerate the pace of discovery and inform evidence-based policy development to strengthen society.

**Responsible body:** Decentralised - National Government to another public body

Funded by UK Research and Innovation (UKRI) through the Economic and Social Research Council (ESRC) with contributions from their partners

**User groups:** Anyone/Public

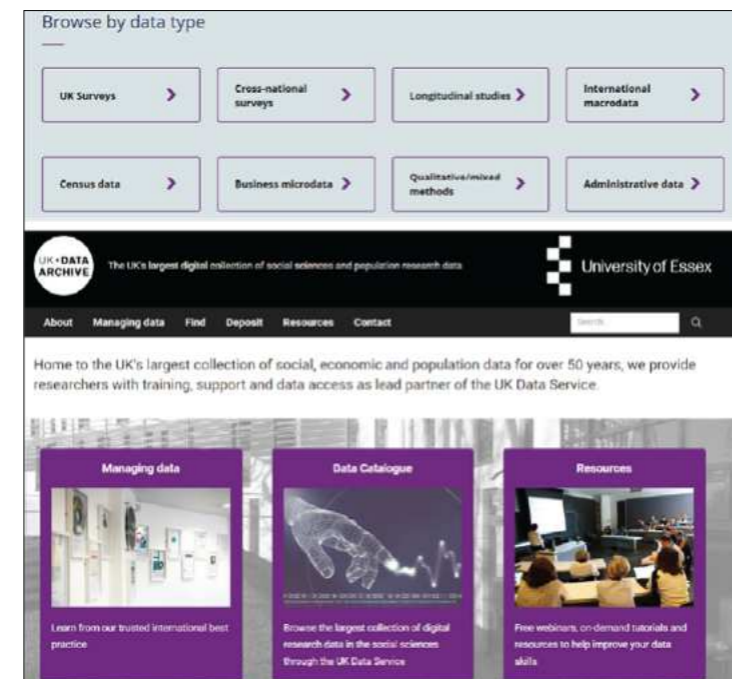
**Sectors:** Health, Civic Engagement, Economy, Environment, Energy, Education, Social/Demographic

Ageing, Crime, Economics, Environment and Energy, Education, Ethnicity, Food, Health, Housing, Information and Communication, Labour, Politics, Poverty

**Purpose:** Data information, Developing, Learning and development  
Transforming social science research, teaching and learning with accessing high quality data

#### Partners and Collaborators

Academic institutions, government departments, research councils and non-profit organizations



### KEY FEATURES

- being a trusted provider of social, economic and population data for research and teaching; offering support and training services to help researchers make the most of the data available;
- vast collection of data from various sources including national surveys, censuses and administrative data
- a national data archive (UK Data Archive (data-archive.ac.uk)), visual demonstration of use cases.

# NATIONAL

## France: Open Platform for French Public Data

<https://www.data.gouv.fr/en/>

### OVERVIEW

#### Mission

To provide the publication of data by the Administrative Authorities of Public Information and by any Data Contributor whose publication is of public interest, the consultation or downloading of this data by any User, a discussion around the data, as well as the dissemination of Enriched Datasets or Reuses.

#### General info

The open public data platform of the French Government.

**Responsible body:** Centralised - National Government

The Etalab mission (hereafter, Etalab) of the Interministerial Directorate for Digital and the State Information and Communication System (DINSIC)

**User groups:** Anyone/Public

Any person accessing the Platform in order to consult or download context or to contribute to it

**Sectors:** Social/Demographic, Environment, Waste, Health, Energy, Civic engagement, Education

Elections, Energies, Geographic Data, Housing and Town Planning, Use, Health, Security, Public Accounts, Associations and foundations, Machine Learning

**Purpose:** Data information, Collaboration and networking, Data repository

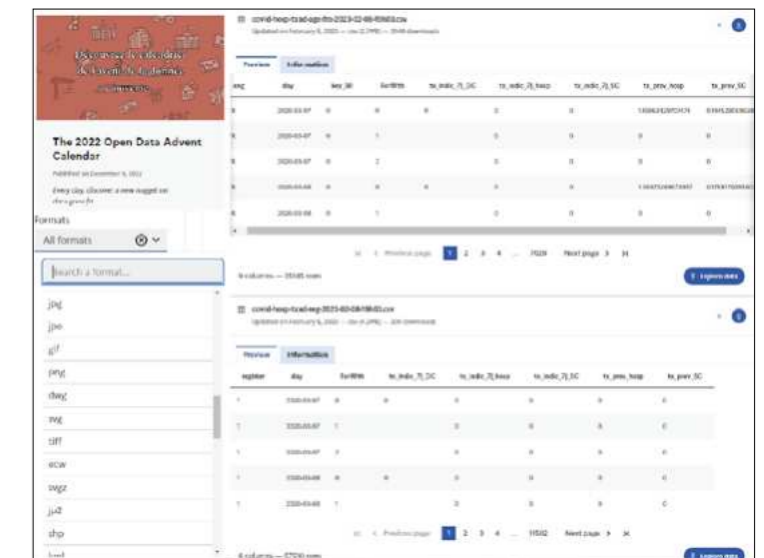
To make available, with a view to facilitating their reuse, the reference data sets that have the greatest economic and social impact

#### Partners and Collaborators

Government agencies, academic institutions, non-profit organizations, and private companies

### KEY FEATURES

- organizing public engagement with outreach events; encouraging collaboration between government agencies and the private sector to promote data-driven solutions; a graphical preview tool for datasets and options to download various data formats.



## 2 KPI Matrix

KPI ID	KPI	Description	N/A (non-applicable)	Metrics				Source
				Missing	Business as usual BAU	Stretch	Pioneering	
	<b>Quality</b>							
Q1	Accuracy	The degree to which the data matches the real world.	N/A	Non-qualified estimate	2D data, low level of detail	3D data, high level of detail	Live data, digital twin	Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a>
2Q2	Precision	The level of measurement and exactness.	N/A	Non-qualified estimate	Non-verified data partly based on assumptions	Verified data partly based on assumptions	Verified data based on measurement	Khasreen, Monkiz & Banfill, Phillip & Menzies, Gillian. (2009). Life-Cycle Assessment and the Environmental Impact of Buildings: A Review. Sustainability. Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> .
Q3	Validity	Following unified standards	N/A	No standards	Standards are documented standards	Data partly following its defined standards	Data following internationally recognized standards	Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a> .
Q4	Transparency / Integrity	Confidence in the data source, availability of information on data.	N/A	No information on data sources	Limited information on data source and methodology	Detailed information on data source or methodology	Detailed information on data source and methodology	Peng, Ge & Privette, Jeffrey & Kearns, Edward & Ritchey, Nancy & Ansari, Steve. (2015). A Unified Framework for Measuring Stewardship Practices Applied to Digital Environmental Datasets. Data Science Journal. 13. 231 - 253. 10.2481/dsj.14-049. Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a> .
Q5	Completeness	Comprehensiveness and wholeness of the data.	N/A	Important data is missing for cities / not covering major sectors of the platform	Covering few cities and sectors	Covering most of cities and regions and sectors	Covering all cities and regions and sectors	Khasreen, Monkiz & Banfill, Phillip & Menzies, Gillian. (2009). Life-Cycle Assessment and the Environmental Impact of Buildings: A Review. Sustainability. Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> .
Q6	Timeliness	<p>“Data should be timely enough to influence management decision making at the appropriate levels. Key issues</p> <p>1.The data are available frequently enough to influence the appropriate level of management decisions.</p> <p>2.The data are current enough when they are reported.”</p>	N/A	Generation date is unknown	Data generating / updating in long intervals	Data generating / updating in short intervals (regularly)	Realtime data update	<a href="https://www.precisely.com/blog/data-quality/does-your-data-measure-up-assess-data-quality">https://www.precisely.com/blog/data-quality/does-your-data-measure-up-assess-data-quality</a> . Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> .



KPI ID	KPI	Description	N/A (non-applicable)	Metrics				Source
				Missing	Business as usual BAU	Stretch	Pioneering	
<b>Accessibility</b>								
A1	Open data	The data are set in the correct format and hosted in a way that is common and open.	N/A	Data is available under open license but not structured (e.g. pdf)	Structured data under open license (e.g. excel)	Non-proprietary open format (e.g. csv)	Non-proprietary open formats. URIs and links to other data	Tim Berners-Lee 5-star deployment scheme for Open Data. Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a>
A2	Registration requirements	Requirements to be able to view and download data.	N/A	Restricted access for specific users only	Registration required / fee or subscription	Partly no registration required / partly no fees or subscription	No registration required / no fees or subscription	Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a>
A3	Format diversity	Number of formats that can be downloaded and their applicability.	N/A	Data is not available in machine-readable format	One machine-readable format	Two machine-readable format options	Three or more machine-readable format options	Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a>
A4	Format accessibility	Open and accessible formats, editable and easy to integrate in different workflows.	N/A	Data is not available in useable format	Data is available for download such as csv, shp, kml, json	Data is available as API only	Data is available to download and API	Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a>
A5	Guidance / documentation	Availability of documentation and guidance on using the data and platform.	N/A	No documentation online	Basic documentation	Intuitive and interactive documentation	Live support	Peng, Ge & Privette, Jeffrey & Kearns, Edward & Ritchey, Nancy & Ansari, Steve. (2015). A Unified Framework for Measuring Stewardship Practices Applied to Digital Environmental Datasets. Data Science Journal. 13. 231 - 253. 10.2481/dsj.14-049. National Cyber Security Strategy 2020. Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a>
A6	Storability	The way the data get stored and its availability for the users.	N/A	Data is not stored or archived	Stored data is available only for the owner	Reviewing the stored data is available for users	Stored data is available and useable for all users safely	<a href="https://pdf.usaid.gov/pdf_docs/pnaec151.pdf">https://pdf.usaid.gov/pdf_docs/pnaec151.pdf</a> Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a>

KPI ID	KPI	Description	N/A (non-applicable)	Metrics				Source
				Missing	Business as usual BAU	Stretch	Pioneering	
<b>Usability</b>								
U1	Performance	<p>“The stability of the platform offering seamless surfing through the website and is eligible for traffic capacity, based on 3 criteria:</p> <ol style="list-style-type: none"> <li>1. Largest Contentful Paint (LCP - measuring perceived load speed because it marks the point in the page load timeline when the page’s main content has likely loaded—a fast LCP helps re-assure the user that the page is useful).</li> <li>2. First Input Delay (FID - measuring load responsiveness because it quantifies the experience users feel when trying to interact with unresponsive pages—a low FID helps ensure that the page is usable.).</li> <li>3. Cumulative Layout Shift (CLS - measuring visual stability because it helps quantify how often users experience unexpected layout shifts—a low CLS helps ensure that the page is delightful).”</li> </ol>	N/A	2 or more performance indicators are poor	At least 1 performance indicator is good	All performance indicators are good	N/A	<p>Definitions and performance tests are based on Google PageSpeed Insights (<a href="https://pagespeed.web.dev/">https://pagespeed.web.dev/</a>)</p> <p>Poor: LCP &gt; 4s / FID &gt; 300 ms / CLS &gt; 0.25 needs improvement: LCP 2.5-4s / FID &gt; 100-300 ms / CLS &gt; 0.1-0.25</p> <p>Good: LCP &lt;2.5s / FID &lt; 100 ms / CLS &lt; 0.1</p> <p>Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy &amp; Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a></p>
U2	Multi-channel access	Engaging and satisfying user experience on multiple access points (e.g. PC, phone and tablet)	N/A	No consistency in experience in more than one access point	Consistent experience across 2 different access points	Consistent experience across PC, phone and tablet	N/A	<p>Suarez, L. (2021) Multi-device experiences, a reality we have to embrace. Available at: <a href="https://medium.com/nyc-design/multi-device-experiences-a-reality-we-have-to-embrace3d051478ee66">https://medium.com/nyc-design/multi-device-experiences-a-reality-we-have-to-embrace3d051478ee66</a>; Meyer, S. (2021) The 7 most important UX KPIs and how to measure them. Available at: <a href="https://www.testingtime.com/en/blog/important-ux-kpis/">https://www.testingtime.com/en/blog/important-ux-kpis/</a>; Levin, M. (2014) Designing Multi-Device Experiences: An Ecosystem Approach to User Experiences across Devices. 1st edn. O’Reilly Media.</p> <p>Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a>.</p> <p>Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy &amp; Approach. Available at: <a href="https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.niua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a></p>

KPI ID	KPI	Description	N/A (non-applicable)	Metrics				Source
				Missing	Business as usual BAU	Stretch	Pioneering	
U3	Inclusion	Ensuring the platform is accessible for all citizens without discrimination of physical or digital abilities or language barriers. This includes compliance with Web Content Accessibility Guidelines as well as providing different language options	N/A	No compliance with and/or GIGW and no language options	Partial compliance with and/or GIGW	High level of compliance with and/or GIGW and providing different language options	Full compliance with and/or GIGW and providing different language options	We utilized the web-based compliance testing tool Accessibility Checker ( <a href="https://www.accessibilitychecker.org/">https://www.accessibilitychecker.org/</a> ). Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Kumar, A. (2021) "Digital and Web Content Accessibility for Persons with Disabilities: A case study of Indian open universities," Research Square, pp. 236–244. Available at: <a href="https://doi.org/10.21203/rs.3.rs-772144/v1">https://doi.org/10.21203/rs.3.rs-772144/v1</a> .
U4	Intuitivity	The website is intuitive to use, both through navigation and through search functionality. The users can quickly find the target information.	N/A	User struggles to find target information	User finds target information intuitively through search only or navigation only	User finds target information intuitively through both search and navigation	N/A	Adobe (2020) UX Strategies for Multiple Devices and Platforms   Adobe XD. Available at: <a href="https://xd.adobe.com/ideas/principles/web-design/ux-design-strategy-for-multiple-devices/">https://xd.adobe.com/ideas/principles/web-design/ux-design-strategy-for-multiple-devices/</a> ; Levin, M. (2014). Designing Multi-Device Experiences: An Ecosystem Approach to User Experiences across Devices. 1st edn. O'Reilly Media; Nichols, K. and Chesnut, D. (2014) Designing Interfaces: Patterns for Effective Interaction Design. 3rd edn. O'Reilly Media. Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . UX For Dummies. Hoboken, NJ, United States: Wiley; Yablonski, J. (2020) Laws of UX: Using Psychology to Design Better Products & Services. 1st edn. O'Reilly Media; Tidwell, J., Brewer, C. and Valencia, A. (2020) Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.nua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.nua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a> .
U5	Interactivity	The interaction between users and computers and other machines through a user interface.	N/A	Platforms contains raw data only	Platform as interactive website with data download options	Website enables visualization of parts or all of the data	Integrated dashboard, enabling live analysis and visualization	Government of India (2015) Implementation Guidelines for National Data Sharing and Accessibility Policy (NDSAP). Available at: <a href="https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf">https://data.gov.in/sites/default/files/NDSAP%20Implementation%20Guidelines%202.4.pdf</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.nua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.nua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a> .
U6	Storytelling	<b>Designers use storytelling to enhance the users' insight, build empathy and reach them emotionally.</b>	N/A	No demonstration of use cases	Report(s) about use cases	Detailed demonstration of use cases	Visual demonstration of use cases (e.g. storymaps)	What is Storytelling? (no date). Available at: <a href="https://www.interaction-design.org/literature/topics/storytelling">https://www.interaction-design.org/literature/topics/storytelling</a> . Ministry of Housing and Urban Affairs (MoHUA) - Government of India (2019) National Urban Innovation Stack - Strategy & Approach. Available at: <a href="https://smartnet.nua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf">https://smartnet.nua.org/sites/default/files/resources/national_urban_innovation_stack_web_version.pdf</a> .

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