

Decoding Digitalization of Urban Governance in India

Policy, People and Processes of the
Smart Cities Mission and
National Urban Digital Mission

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PAPER

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ACRONYMS AND GLOSSARY

ABD: Area-based Development

API: Application Programming Interface. Allows connection between computers, databases, and software.

BIS: Bureau of Indian Standards

CDA: City Data Alliance

CDG: Centre for Digital Governance

CDO: City Data Officer

CDoT: Climate Data Observatory

CDP: City Data Policy

DAM Unit: Data Analytics and Management Unit

DSCS: DataSmart Cities Strategy

DMAF: Data Maturity Assessment Framework

IA: Implementing Agency

ICCC: Integrated Command and Control Centre

ICT: Information and Communication Technology

IDE: Integrated Development Environment

Interoperability: Ability of products or systems to work with other systems.

IoT: Internet of Things

IMAF: Integrated Command and Control Centre Maturity Assessment Framework

IUDX: India Urban Data Exchange

IUO: India Urban Observatory

MDO: Mission Data Officer

MeitY: Ministry of Electronics and Information Technology

MOHUA: Ministry of Housing and Urban Affairs

MOUD: Ministry of Urban Development

MPI: Municipal Performance Index

NIC: National Informatics Centre

NIUA: National Institute of Urban Affairs

NUIH: National Urban Innovation Hub

NUIS: National Urban Innovation Stack



NULP: National Urban Learning Platform

PCP: Pan City Projects

PMC: Project Management Consultants

PPP: Public-Private Partnership

SCDN: Smart Cities Data Network

SCM: Smart Cities Mission

SCMMU: Smart Cities Mission Management Unit

SCODP: Smart Cities Open Data Portal (See Appendix)

SCP: Smart City Proposal

SDG: Sustainable Development Goals

SPV: Special Purpose Vehicle

Stack: Data structure from which data can be added or removed in particular defined order

ULB: Urban Local Body

1. INTRODUCTION

The presence of digital technology within urban governance in India is not new. Computerization and the use of enterprise software was encouraged in municipalities through the 1990s, followed by varied e-governance reforms in the early 2000s. These ranged from centralized policies like the *National e-Governance Plan* (NeGP), to projects such as the *Jawaharlal Nehru National Urban Renewal Mission* (JNNURM), and city and state initiatives such as online billing and certification services for citizens and GIS platforms for administrators. The *Smart Cities Mission* (SCM) launched in 2015, gave a substantial and centralized push for digital interventions by choosing 100 cities to create “smart solutions” for urban governance, planning, and digital infrastructures. These were seen as “lighthouse” cities, expected to create technology-centric solutions that could be emulated by other cities in the mission (MOUD 2015: 5).

As the [SCM](#) draws to a close in 2023, the *Ministry of Housing and Urban Affairs* (MOHUA) has launched a new mission in February 2021 called the *National Digital Urban Mission* (NUDM). The NUDM aims to extend the vision of the [SCM](#) beyond the 100 smart cities to other *Urban Local Bodies* (ULB) in the country. The [SCM](#) can be seen as a test bed for digitalization, lessons from which the NUDM carries forward. Therefore, we see these two central policies that push for the digitalization of urban governance as having a clear overlap of objectives, institutions, and processes.

Existing literature has studied the progress of the [SCM](#) in fragments. This scholarship analyses early [SCM](#) policy documents and plans (Khan, Taraporevala, and Zérah 2018; Taraporevala 2018), theorizes smart cities in the Indian context (Datta 2015), understands the role of global financial corporations in the mission (Purandare 2021), evaluates citizen participation and the impacts on local government (Paharaj, Hoon, and Hawken 2017). It also raises questions about surveillance, privacy, and data justice (Purandare and Parkar 2021). Other literature identified later looks at specific cities or technologies.

However, since its inception, the [SCM](#) has evolved substantially beyond its original policy views, with significant yet undocumented changes. These involve the creation of supplementary policy modifications

that drive digitalization processes, and shape implementation of specific interventions through infrastructure and software as “smart solutions”. This comes with the institution of new administrative and technical institutions and bureaucracies that oversee digitalization and push for the creation and utilization of data-driven governance. [MOHUA](#) also tries to evaluate the progress of the 100 cities through various assessment frameworks. The NUDM, which furthers digitalization and focuses on data-driven governance, has received no attention in literature owing to its infancy.

The [SCM](#) and the NUDM are also more emphatic interventions in the digitalization of urban governance than previous e-governance projects, which have been understudied in the Indian case. For us, digitalization of urban governance can be understood in three broad ways – first, in the implementation of e-governance tools, such as web portals and mobile applications for providing municipal information, billing services, and certifications; second, in the use of digital infrastructures such as sensors, smart meters, and platforms to monitor and collect data on the city; and third, through *datafication* – the use of data collection and analytics, algorithms, and Artificial Intelligence & Machine Learning (AI & ML) to automate decision-making.

While some literature identified below evaluates the progress of digital initiatives under the JNNURM and the NeGP as projects, it does not effectively address what are the tools, institutions, practices, and effects of digitalization on urban governance.

This report is aimed at providing a structured view into the digitalization of urban governance in India, through its policies, institutions, and processes with a particular focus on the [SCM](#) and its influence on the NUDM.

Scope

Early literature identified above on the [SCM](#) substantially breaks down the core policy document – the *Smart Cities Mission Guidelines*. Recent scholarship includes policy-focused literature (Prasad and Alizadeh 2020), city-specific literature (Prasad et al. 2021) and technology-specific work (Datta et al. 2021;



Praharaj 2021). However, these works exclude multiple substantial developments since the [SCM](#) was launched.

These developments include strategy documents for cities to follow a centralized vision of digitalization, standardization guidelines for technical and data specifications, and teams housed at the *National Institute of Urban Affairs* (NIUA)¹ and [MOHUA](#) to monitor the progress of digital projects through evaluation frameworks. Other developments include new city-level staff positions responsible for data-driven governance, and data exchange platforms.

We argue that since the [SCM](#)'s inception, these supplementary policies, personnel, and practices have shaped digitalization and administrative processes in cities far more significantly than the core policy document (the [SCM Guidelines](#)). These developments need to be deconstructed to understand the vision of digitalization of urban governance being pushed through the missions.

For instance, the *DataSmart Cities Strategy* became one of the key guidelines for cities to follow a digital pathway. In addition, the *Centre for Digital Governance* at the [NIUA](#) was tasked with developing subsidiary policies and institutions, assisting cities in formulating digitalization practices, and creating monitoring systems. *City Data Officers* (CDO) were appointed and trained to improve data collection and analysis practices, and use cases were promoted by platforms like the *India Urban Data Exchange* (IUDX).

In this report, we attempt to trace the complex ecosystem that the [SCM](#) has created. Even though the [SCM](#) will end by 2023, the ecosystem will likely outlive not only the Mission itself but the trend of the “smart city”. We show how this influences the NUDM and predict that it will shape future digitalization of urban governance in policy and practice. Alongside this, we try to demonstrate how policies could spawn into far more complex infrastructures and processes with path dependencies of their own.

Given the proposed aim of this working paper, we believe that researchers interested in specifically studying

India's Smart Cities Mission and National Urban Digital Mission or generally interested in the paradigm shift of Indian urban policy towards digitalization will find something of interest here. This report offers insights into smart city and urban digitalization policies, strategies, actors, bureaucracies, institutions, platforms, and technologies. We have attempted to highlight the connections among these aspects and, where relevant, their diversity of purpose. Readers will be able to delve deeper into their primary interests through the appendix as well as the links to documents and websites. Considering the large number of acronyms, readers can click the in-text hyperlink to directly access the glossary for easier reference.

Questions

The report aims to answer the following questions: What are the policy frameworks and guidance documents that drive the digitalization of urban governance in India? What are the institutions and offices created through this policy to assist digitalization? What are the various technologies and platforms that are instrumental in shaping digitalization at the city, state, and national levels?

We address these questions by reading the new [SCM](#) and NUDM guidelines that drive digitalization, identifying institutions and bureaucracies that supervise and evaluate progress, recognizing technologies and platforms created to meet the goals of digitalization, and highlighting certain practices in cities that work under the missions.

Sources

We refer largely to public documents published by the [MOHUA](#) and the [NIUA](#). Most policy documents and frameworks are available on institutional websites. Instead of focusing on the [SCM Guidelines](#), we bring to light supplementary documents such as the *DataSmart Cities Strategy* and *National Urban Innovation Stack* which are created as guidance documents for cities to improve digitalization. In many cases, these supplementary documents link to assessment frameworks which are used to rate and rank cities along various parameters.

1 The [NIUA](#) is constituted as a research agency and think tank for urban planning and development. It provides technical assistance to the [MOHUA](#) and cities and states for urban policy, programs and projects.

Some information is available on web portals such as *SmartNet*, or webpages of specific projects on [MOHUA](#) or [NIUA](#) sites, or in press releases, but are not necessarily issued or published as “documents” from the Ministry – we also consider these web pages in our reading since their content significantly reflects or influences practices of digitalization.

Some of the recommendations in the policy documents are modified in practice. To understand this, interviews were conducted with [MOHUA](#) and [NIUA](#) officials who offered a clearer picture of how policy interventions are structured and implemented in various institutions and cities. Interviews with consulting firms and social sector representatives involved in the [SCM](#) have been used to bolster this understanding.

Some components of the [SCM](#) and the NUDM exist in these supplementary documents but are not necessarily fully operational at this stage. To show linkages between components and to understand the continuity in digitalization practices, we outline these based on the documentation even though we have not been able to verify them in practice. Some components are defunct or have been adopted or absorbed into other components of the Mission, and we try to distinguish those wherever possible.

While we do provide citations when we use specific wordings from the policy documents, or specific interviews, we do not always give in-text citations for specific projects or components of the [SCM](#) and NUDM – this is because most interventions have more than one source document, website or institutional source. Some initiatives of the Mission do not come from any specific policy documents but appear in practice, either at the central or the city level – we try to identify the genesis of most initiatives, however, there may not be direct documentary linkages. We attempt to clarify instances where this is the case.

We provide links to policy documents wherever available. We also have added multiple documents in the appendix which may not have been referred directly by us but contribute to the outcomes of the missions.

Owing to the large number of documents, institutions, organizations, and platforms there are multiple acronyms in use. We provide a glossary at the beginning of the document to assist the reader. The appendix summarizes and links to all documents and platforms, some of which are not addressed in the main text. All figures in the document are illustrated by the authors

Structure

We begin with a short genealogy on the digitalization of governance in India before turning to the [SCM](#). We then chart out the various strategy and policy documents created after the original guidelines. We show how these documents are important because they define digitalization clearly, standardize technologies and data, and create monitoring and evaluation strategies for cities. Following this, we try to locate drivers and monitors of the digitalization projects, for which we trace central and city-level actors and teams. Specifically, we look at the *Special Purpose Vehicle* (SPV)² structure and see how new positions like City Data Officers are significantly poised to coordinate digitalization strategies.

We then move on to the specific implementation of digitalization by looking at certain platforms, again at the central and city level. We show how these platforms guide cities, integrate various technologies, and share data. This includes a discussion on the functioning of infrastructures like *Integrated Command and Control Centres* (ICCCs), which have become a mainstay of the 100 smart cities and are described as a city’s nerve centre.

Finally, we conclude with a section that identifies possible future research directions considering the vast domain of digitalization.

1.1 Genealogy of Digitalization – from JNNURM to NUDM

While the [SCM](#) claims to be a novel approach to urban development, digitalization in Indian cities can be traced back to the 1990s, with the mid-2000s seeing a reinvigorated impetus. Therefore, to understand the trajectory of digitalization in urban India, and thereby

2 The [SPV](#) or Special Purpose Vehicle is, as stipulated by the [SCM](#) Guidelines, the smart city governing body at the city-level. We discuss the [SPV](#) in greater detail under Section 3. For more information see Khan, Taraporevala, and Zérah (2018).



understand the [SCM](#) and NUDM better, it is necessary to briefly discuss other comprehensive urban policies introduced in India prior to 2015, with a coordinated focus on digital technologies and e-governance. These were the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and the National e-Governance Plan (NeGP), launched in 2005 and 2006 respectively. Many of the benefits of e-governance and digitalization that are underscored by the Smart Cities Mission, like increased transparency, efficiency, convenience, participation, and accountability, were also promised by the JNNURM and NeGP.

Like the [SCM](#), the JNNURM was also a mission-mode urban policy. Its core interventions focused on 65 Indian cities while some of its other projects were designed to be implemented across smaller cities, towns, and census towns in the country. The central government's funding to cities was conditional on a set of mandatory and non-mandatory reforms (Kundu 2014). E-governance was one of the mandatory reforms (ibid) and included the introduction of e-governance services that citizens could access and institutional computerization of the [ULBs](#). Mainly, these services were expected to cover eight e-governance modules, including birth and death certificates, grievance redressal, accounting, licensing approvals, and taxes (Chatterji 2018).

One of the most common critiques of the JNNURM is the unevenness of development across the 65 cities. Even after extending the Mission for an additional two years, most cities were unable to complete the eight e-governance modules (Kundu 2014). Despite there being supplementary guidelines, toolkits, and platforms issued during the JNNURM, the literature does not identify how they shaped e-governance projects or how they transformed municipal functioning.

Similar interventions were mentioned in the National e-Governance Plan, introduced in 2006, with the explicit vision of easing citizens' access to government

services (Chauhan 2009). According to Chatterji, "One of the components of the plan, 'e-municipality' was designed to improve the functioning of the municipalities through greater application of Internet and [ICT](#)-enabled Management Information Systems (MIS) in their everyday work process" (2018: 338). The digitalization of municipal services according to the NeGP, was to be carried out by state governments (Chauhan 2009). Learning from state experiences, the JNNURM and NeGP acknowledged the importance of developing digital infrastructures so that more people would have access to the internet, and recognized a need for capacity building among citizens and government officials so that digital services would be used more effectively (Chatterji 2018).

These interventions were implemented unevenly. Some cities were far more successful in digitalization projects as compared to others (Kundu 2014; Chatterji 2018). Many of these cities, like Pune, Surat, Delhi, and Bangalore are also mission cities under the [SCM](#). It is worth mentioning that cities and states also took their own digitalization initiatives. However, we are unable to uncover the varied experiences due to a lack of literature on them. At the same time, we encountered many of these initiatives from NeGP, JNNURM, and other city or state projects during our fieldwork. These initiatives ranged from grievance redressal platforms, enterprise software, and billing and certification systems. Some of these have become defunct, some were transferred to [SCM](#) platforms, while others continue to thrive.³

Since 2015, the Government of India has introduced a variety of projects that focus on digitalization in several sectors ranging from public services to health to entrepreneurship. Some of these have been introduced under the umbrella of the *Digital India*⁴ initiative, while other initiatives are being developed by different ministries. Our focus is on the urban policies, [MOHUA](#)'s⁵ Smart Cities Mission (2016), and National Urban Digital Mission (2021). The original guidelines of

3 For some examples of e-governance legacies and their influence on digitalization in the [SCM](#), see Parkar et al (2023).

4 Digital India is a Government of India campaign which encompasses projects across departments and ministries that enable digital delivery of governance services to citizens and improving internet connectivity.

5 When the [SCM](#) was launched in 2015, the nodal ministry was the Ministry of Urban Development (MOUD). In 2017, the [MOUD](#) was reintegrated with the Ministry of Housing and Urban Poverty Alleviation to form the Ministry of Housing and Urban Affairs (MOHUA), which is now the nodal body. We use the new name and acronym [MOHUA](#) to avoid confusion.

the [SCM](#) have been elaborated by (Khan, Taraporevala, and Zérah 2018; Praharaj and Han 2019; Taraporevala 2018) among others.

The following is a summary of the literature which breaks down the Smart Cities Mission Guidelines (henceforth *Guidelines*) issued in 2015. The key observations in the literature are the vague definition of “smartness” or digitalization despite a defined list of “core infrastructure elements” and “smart city features”; the competitive process for the finalization of the 100 smart cities; the creation of new governance structures in the form of the [SPV](#); inclusion of *Global Consultancy*

Firms (GFC) as “handholding agencies” and *Project Management Consultants* (PMC); and the funding of *Area Based Development* (ABD) and Pan City projects.

Rather than being implemented by the [ULBs](#), the *Guidelines* made [SPVs](#) mandatory to roll out the mission. [SPVs](#) have been described as an “ad-hoc governance structure” (Khan et al 2018: 81) and were formed as companies helmed by a CEO and board of directors, with representation from city and state agencies. Various private sector actors like consultants, technology vendors, and system integrators work closely with these [SPVs](#).

2. DEFINING, STANDARDIZING, AND EVALUATING DIGITALIZATION – SUPPLEMENTARY GUIDELINES

In this section, we introduce supplementary policies that were issued after the *Guidelines*, to assist cities in improving their implementation of digitalization and datafication. We show how the early years of [SCM](#) did not see substantial digitalization interventions by cities, and these supplemental policies are intended to handhold cities. These documents also shaped changes in the city, such as hiring City Data Officers and pushing toward ICCCs. We also find that these documents pushed cities towards more efficient data practices.

While the *Guidelines* asked cities to use “smart solutions”, it did not define or illustrate digital technologies or datafication, and specific interventions were left to the imagination of the cities. While e-governance services, IT connectivity, and digitalization were mentioned, smart solutions were kept vague hoping that cities, incubation labs, hackathons, and industry would devise locally generated technological solutions. The *Guidelines* seemed to focus on infrastructure development, especially under [ABD](#) projects. In interviews with officials from [MOHUA](#) and [NIUA](#) as well as with consultants it was indicated that while some cities had introduced technology solutions, they were still treating the [SCM](#) as an infrastructure development project (Interview [MOHUA](#) 2021, Interview [NIUA CDG](#) 2021, Interview Tata

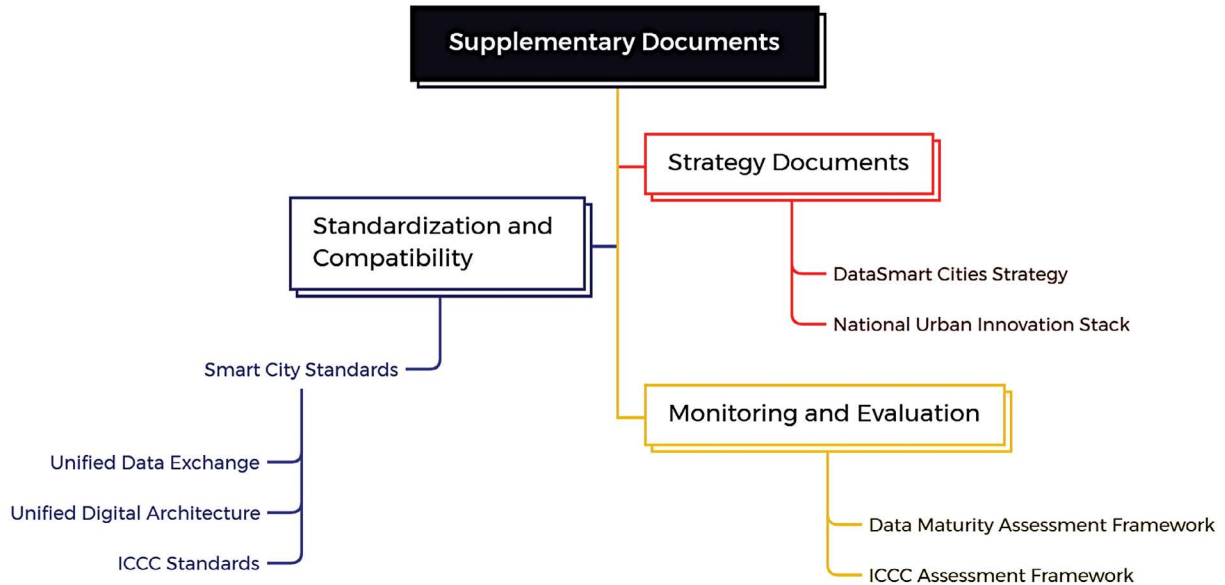
Trusts 2021). Monitoring committees also reported that data gathered from cities was substandard, inconsistent, and non-granular. Thus, this data did not have any analytical possibilities (Interview [DMAF](#) 2021).

As a result, [MOHUA](#) decided to introduce additional guidance documents to help cities develop a clearer vision for digitalization and datafication. Multiple committees consisting of members from [MOHUA](#), [NIUA](#), PWC, Bureau of Indian Standards, Tata Trusts’ *Data Driven Governance*, and the *EGov Foundation* created draft documents that were modified and issued by the [MOHUA](#). In this section, we summarize some of the key documents which have instituted significant changes in the implementation of the , especially in the creation of data personnel like City Data Officers and platforms like the *India Urban Data Exchange* (IUDX).

These supplementary guidelines can be grouped into three approaches – first, documents that advise and assist cities in creating digitalization strategies; second, documents that push for setting up standards to ensure common technologies and compatibilities; and third, documents that lay out the plan to evaluate and monitor the progress of cities.



Figure 1: Supplementary Documents of the [SCM](#)



2.1 Creating Digitalization Strategies – *DataSmart and Innovation Stack*

In this section, we introduce two key documents, the DataSmart Cities Strategy (MOHUA 2018a) and National Urban Innovation Stack (MOHUA 2018b). We consider these two documents as key to digitalization since their release in 2018 as they clearly define and introduce digitalization, suggest datafication cases, push cities to hire bureaucracies to fulfil digitalization targets, and lay the ground for evaluating and monitoring city-level digitalization.

DataSmart Cities Strategy

The DataSmart Cities Strategy (DSCS) was introduced to address the lack of “data culture” in Indian cities. The DSCS suggests that cities that adopt and build a data culture are better poised to improve their decision-making. Some of the ways to institutionalize a data culture include hiring data-centric staff, creating data

platforms, formulating data policies, assessing data requirements and publishing data including “cross-cutting” data sets (i.e., those across departments or silos) and introducing city-wide challenges for urban innovation (MOHUA 2018a: 51). We recognize the DSCS as the first document under the [SCM](#) that clearly defines the digitalization pathways that cities could follow.

The [DSCS](#) introduced the concept of building the smart city “as a platform” (MOHUA 2018a: 4). This entailed the use of various sensors and [IoT](#) devices across the city to collect data. It suggested that this data be analysed and used to better plan and govern the city, and access be provided to other stakeholders – businesses, academic organisations, and citizens – for their own uses. The [DSCS](#) sought to define a “data smart city”, justify the need for such cities, and laid down the process cities should follow to become data smart. Finally, the [DSCS](#) focused on what it terms the three foundational “pillars” for becoming data smart, viz. people, process, and platform.

“We do not really have a data culture...cities did not know how to use data...they did not see the value of it”

Mission Director, [SCM](#), [MOHUA](#) (11 August 2021)

“The future of Governance is data-driven and Indian cities are beginning to adopt this change in their functioning. Bringing data in ‘focus’ ensures a move towards outcome-based planning in governance.”

(MOHUA 2018a: 17)

The [DSCS](#) recognized that there was no specific authority or personnel within [SPVs](#) that would be responsible specifically for digitalization since tasks were spread between multiple officers and [SPV](#) Project Management Consultant (PMC) teams. It thus introduced new roles and responsibilities in order to execute the process of becoming “datasmart”. People were expected to champion the collection and use of data from the local to the national level. The [DSCS](#) also underscored the importance of having clearly assigned roles to seamlessly implement this strategy and sustain it. As far as possible, the document suggests, new roles and responsibilities should be integrated within existing institutional structures. Two examples of these personnel can be found in the City Data Officers appointed at the city level and the *Data Analytics and Management Unit* (DAMU) at the central level, both of which are detailed in the sections below. While the *Guidelines* mentioned a State-level *High Powered Steering Committee* (HPSC) to monitor the Mission, these later documents mention the state government’s role as only advisory. On the other hand, the NUDM works directly with the state government rather than with the city.

The [DSCS](#) encouraged cities to institute certain structures and processes to streamline data governance and ensure that the data collected is properly stored and secured. This means identifying the data that is needed, streamlining the collection and cleaning of the data, ensuring data security and privacy, and integrating data sets across city departments and even nationally. Toward these ends, the [DSCS](#) recommended drafting data standards, creating a coordination system within the city, classifying data into personal and non-personal data, and, most importantly, drafting a City Data Policy. We have elsewhere identified that India does not have a binding data protection law (Purandare and Parkar 2020). In the absence of these data protections, the [DSCS](#) becomes an important document to regulate the use of data collected by cities and provides guidelines for each city to develop a paralegal framework to operate within.

We suggest the [DSCS](#) is a foundational document that significantly influences the digitalization of urban governance and becomes the template for further documents, institutions, hiring of personnel, and setting up of platforms. As vague as the *Guidelines* were in reference to “smartness”, the [DSCS](#) is as precise in suggesting specific digital interventions, data-driven governance, and institutional changes in the [SPV](#) to enable these. The [DSCS](#) also creates the foundation for other documents such as the *Smart City Standards* by justifying the need for standardized data access.

Platforms are... “a set of digital infrastructure components needed for the management, analysis and use of data for a data-led governance”

(MOHUA 2018a: 41)

National Urban Innovation Stack

The 2019 National Urban Innovation Stack ([NUIS](#)) extended the agenda of digitalization and datafication set out in the [DSCS](#) by creating certain design principles, defining digital components, platforms and standardization. The [NUIS](#) suggested the creation of a “shared digital infrastructure” and a “common public good”, accessible to state and non-state actors ([MOHUA](#) 2018b: 11). It aimed at systematically organizing India’s urban data and employing this data for a variety of purposes.

The primary justification offered for creating the [NUIS](#) was the need for easy access to vast amounts of data, and its analysis for enhanced decision-making in urban India. One of its key objectives was to better integrate this data across departments within cities and across city, state, and central levels. The [NUIS](#) also aimed to

make data more accessible, to put certain guidelines and standard operating procedures in place, and to bring together government, citizens, the private sector, and academia to collectively improve India's urban landscape. This strategy document argued that all of this “can be achieved through a *stack-based* approach, wherein complex multifaceted challenges are unbundled and abstracted into specific micro-problems” (emphasis ours, [MOHUA 2018b: 27](#)).

The [NUIS](#) can be understood as a collection of technological interventions and platforms that all Indian cities can access and contribute to. This is the “stack-based” approach, where cities can build components on common foundational blocks and adapt interventions to their needs. For this, the [NUIS](#) laid down some principles, standards, and specifications in order to ensure accessibility, privacy, and interoperability between technologies.

The [NUIS](#) strategy document recommended the use of certifications in order to ensure standards and specifications and to engender trust in the stack.

The [NUIS](#) imagined that digital components and platforms will create data infrastructure, deliver urban services, and create data-driven solutions for urban problems. It suggested that these components will reduce paperwork, use digital payment systems and be transparent in their data use. The data infrastructure is the collection and organization of urban data that is accessible across departments and agencies which can be used for analysis, innovation, and decision-making.

The [NUIS](#) aimed to offer common solutions for cities to adapt and apply. These solutions remain building

Data registries “enable decision makers across organizations to have access to common sets of data that are logically organized and act as a shared source of truth, to improve collaboration and decision-making in the ecosystem”

([MOHUA 2018b: 36](#))

blocks and tools that cities can access to tailor-make their own solutions without having to create systems from scratch. Solutions included examples of traffic management systems, grievance redressal, employee learning, and streamlining building plan approvals.

At the moment, there are seven key programs created under the [NUIS](#), brief descriptions of some can be found in the appendix. One of the programs – the India Urban Data Exchange (IUDX) – is ideated in the [DSCS](#), but developed substantially in the [NUIS](#). While the [DSCS](#) creates the larger vision of data institutions, programs, peoples, and processes, the [NUIS](#) can be seen as a document that provides more coherent design and implementation strategies for these interventions. Thus, programs like the [IUDX](#) may be suggested in the [DSCS](#), but its architecture, structure, and design are elaborated in the [NUIS](#).

At this stage, most of the initiatives under the [NUIS](#) are driven by the *Centre for Digital Governance* (elaborated below) which has been supervising the rollout of multiple projects.

“[NUIS](#) is 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 that enable the ecosystem players to innovate on the stack. Together, these services and standards create a powerful framework to drive convergence and a faster implementation cycle for any urban initiative”

([MOHUA 2018b: 31](#))

‘the strength of the microservice-based stack approach is that each new program will create reusable services that can be used by future programs, thereby increasing the speed of solutioning’

(MOHUA 2018b: 40)

2.2 Making Technologies and Data Compatible – *Smart Cities Standards*

While some broad standardization principles are laid out in the [DSCS](#) and [NUIS](#), these are not technically specific. To ensure that sensors, platforms, software, and other digital infrastructure are viable, there was a need to set out technical standardizations. This standardization was necessary to ensure the interoperability of multiple technologies and platforms as well as to ensure data-sharing efficiency across systems.

The [MOHUA](#) and [NIUA](#) worked with the *Bureau of Indian Standards* (BIS)⁶ to create these standards, and a Sectional Committee of the [BIS](#) was set up with representatives from government, industry, and academia. Over three years, the [BIS](#) developed 15 Smart City Standards and launched them in 2020, with an official release in 2021. These focused mainly on data and the use of technological systems such as GIS, sensors, and networks. ICCCs are positioned to adopt and apply these standards in their implementation ([NIUA](#) 2021). The *Unified Digital Infrastructure – ICT Reference Architecture* standards document (IS 18000:2020) is the most comprehensive standards document for any digitalization of urban governance practice in India. Importantly, it defined the “Unified Digital Infrastructure” by explicating standards for [ICT](#) infrastructure such as sensors, implementation, and regulation of data systems, [IoT](#) systems for connectivity between tools and applications and platforms to govern all of these. Any component of the [DSCS](#) or [NUIS](#) can be implemented through the standards set out in this document. Other examples of standards include *Smart Cities – GIS* (IS 18008: 2020) standards which define key formats and use cases for GIS platforms; or *Unified Data Exchange* standards which lay out the architecture and

processes necessary for instituting data exchanges or marketplaces.

Since many cities contracted ICCCs under the [SCM](#) well before the guidance documents, they were built with varying sensors and platforms that acquired data. Different GIS platforms or data engines were used depending on the vendors for these systems. As a result, file formats and communications between devices and data systems vary from city to city. The ICCC Standards have been created so that there is interoperability of technologies and sharing of data between technological systems regardless of the types of ICCC architecture instituted by cities. The standards are also necessary for the integration with national platforms like the [IUDX](#) elaborated below.

All standardization documents are available at [this link](#).

2.3 Evaluating Progress of Digitalization – *Assessment Frameworks*

Apart from publishing strategy documents and policy guidelines, the [MOHUA](#) has established several assessment frameworks to measure the progress of digitalization and datafication in cities over time. It is important to note that these assessment frameworks go beyond simple monitoring, and enforce certain standardized protocols and practices in the implementation of digitalization.

Some of these evaluation frameworks require self-monitoring or self-reporting but are also supervised and regulated by agencies within the [MOHUA](#) and the [NIUA](#). We use the Data Maturity Assessment Framework (DMAF) and the Integrated Command and Control Centre Assessment Framework (IMAF) to illustrate the

⁶ [BIS](#) is the national standardization body established under the BIS Act 2016 to create manufacturing, scientific, and consumer standards.



centralized monitoring and evaluation of datafication in cities. Other frameworks instituted by [MOHUA](#) are available in the appendix. All framework documents have been included in the document repository.

The [DMAF](#) evaluates the progress of cities in digitalization and datafication – it monitors whether cities are hiring requisite staff, creating data policies and strategies, collecting data, and following data protocols set up under [DSCS](#) and [NUIS](#). It also tries to evaluate the quality of collected data, whether

it matches standards and whether it is used for analytics cases. The [IMAF](#) was introduced in 2021 and significantly expanded on the integration of digital components set out in the [NUIS](#). Since all digital infrastructure connects to the Integrated Command and Control Centres, the [IMAF](#) is aimed at evaluating if cities are effectively able to utilize the collected data. It also offers use cases for cities to implement solutions such as traffic, surveillance, disasters and emergencies, and geospatial analysis.

3. WHO IMPLEMENTS DIGITALIZATION?

Despite the suggestion of administrative hierarchies in the [SCM Guidelines](#), not all positions were created or filled. Most [SPVs](#) did not have dedicated staff to monitor digitalization, and these functions were fulfilled by consultants hired to implement the projects or staff deputed from municipal agencies. To address this shortfall, the [DSCS](#) suggested the creation of multiple new positions within the [SPV](#) to supervise and streamline digitalization. Some positions and teams were suggested at the central and city levels, but again, not all of these positions were created. At the same time, other positions which do not find any mention in the [DSCS](#) or the [NUIS](#) were created at the [NIUA](#) or the city level through government orders or [SPV](#) notifications.

The personnel hired for these teams may not be government officials, but can be appointed on a contract, or as entire teams contracted via consultancies or technology companies. Almost always, the personnel have a background in industry with specialization in technology and/or management. As with previous sections, we highlight only some of the key positions and teams involved in digitalization.

Central Bodies

As identified above, many of the supplementary guidance documents and evaluation frameworks are issued by the [MOHUA](#) and the [NIUA](#). There are multiple teams at the central level for monitoring the rollout of

the [SCM](#) – in particular, the Mission Management Unit, instituted in 2016 to support the “the roll out, execution, oversee, monitor and build capacities of Mission” ([MOUD 2016: 4](#)). The unit monitors the projects under the [SCM](#) and issues financial dispersal for the same. For digitalization, however, there were two new units constituted under the [NIUA](#) which are elaborated below – the Centre for Digital Governance and the Data Analytics and Management Unit.

The [Centre for Digital Governance \(CDG\)](#) is housed at the [NIUA](#) and was created in 2020 to create policies through research, digital infrastructure, platforms, partnerships, and be an advisory body for the [SCM](#), NUDM, and cities. The key agenda of the [CDG](#) is to drive digital technology and data initiatives for urban governance ([CDG 2021; NIUA 2020](#)). Through various teams and projects, the [CDG](#) is responsible for multiple platforms set up under the [SCM](#). While the [DSCS](#) proposes the position of a *Mission Data Officer (MDO)*, no personnel were appointed to fill this position. We find that the functions of the [CDG](#) are closest to this [MDO](#) since it supervises the multiple strategies of digitalization from the centre. The [CDG](#) also assists in the rollout of platforms and technologies under the NUDM.

Another monitoring team, the Data Analytics and Management Unit (DAMU), coordinates with cities on datafication, advises cities on data analytics and legal frameworks, creates case studies, and reviews progress of cities’ use of data in governance. The DAMU

was created in 2020, is housed at the [NIUA](#), and works closely with the [MOHUA](#). Its staff combines employees of [NIUA](#), former Smart City Fellows⁷, and staff deputed from consultancy firms. The DAMU coordinates with [CDOs](#) to review the progress of cities and their conformity with data collection guidelines. As part of its review function, the DAMU has been tasked with managing the Data Maturity Assessment Framework ([DMAF](#)) under which two cycles of review have been carried out. A brief introduction to the evaluation framework has been highlighted above. Even though the [DSCS](#) imagines a *Smart Cities Data Network*, which brings together the [CDOs](#) of all cities along with other administrative and advisory bodies, we have not been able to find any record of this taking place.

While the [CDG](#) and the DAMU are teams at the centre assisting the implementation of digitalization, at the city level, there is a myriad of actors. While there are certain commonalities in the cities owing to the [SPV](#), each city has its variations. We provide a broad description of the positions within the [SPVs](#) and identify some variations to show the commonalities and complexities within structures and hierarchies.

City-Level Organization

The [SPVs](#) are led by a *Chief Executive Officer* (CEO) who tends to be from existing administrative cadres like the IAS or state services but may also come from the private or social sector. In many cities, the CEO is an ex-officio administrative position that comes along with an existing position e.g. of Municipal Commissioner. Other [SPV](#) officials assist the CEO in managerial positions. These managers tend to be organized functionally such as IT, Engineering, Finance, and Planning, with actual positions, hierarchies, and functions differing between cities. The managerial positions tend to be occupied by officers from within state services, and sometimes may be deputed from or have other positions in municipal agencies. Each position within the official structure may also have deputy or additional subordinate positions. It should be noted that while a broad governing structure

is common among the 100 Mission cities, the specific positions vary and may also have changed since the [SPVs](#) were first created.

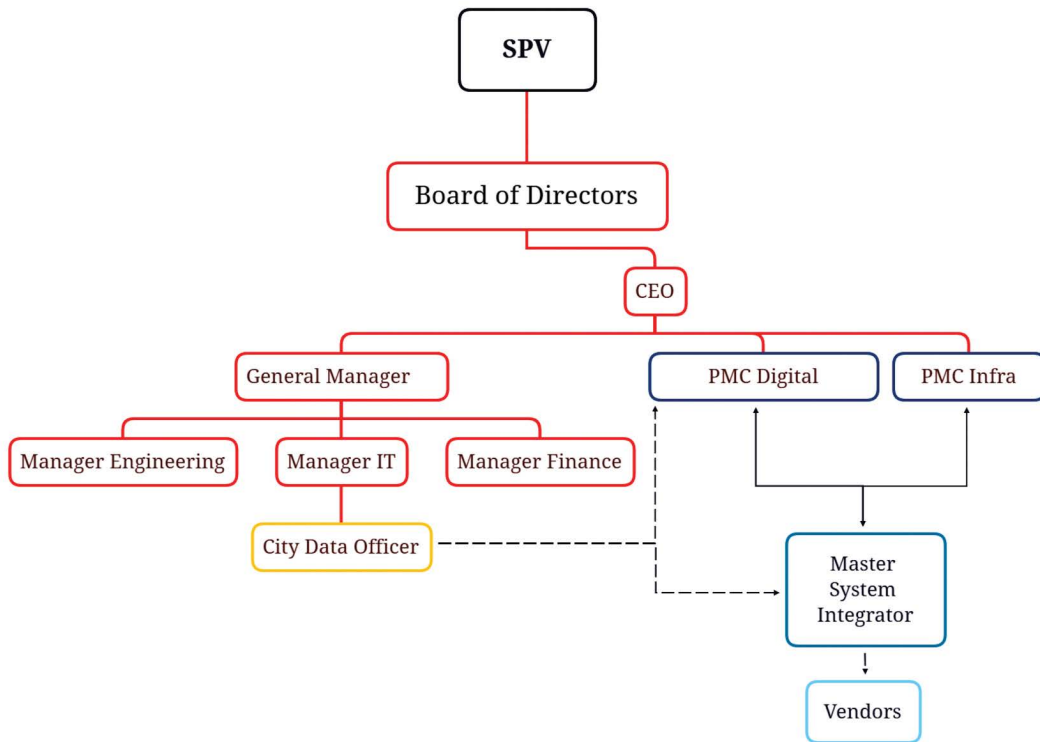
Usually, the CEO is empowered to take day-to-day decisions regarding the city's smart city interventions. The projects are approved by the [SPV's](#) Board of Directors, which is usually made up of the CEO, the municipal commissioner, the city's mayor, the leader of the opposition, and independent directors.

The [SPV](#) hires *Project Management Consultants* (PMCs) to implement the [SCM](#) projects. Some [SPVs](#) have two [PMCs](#) with specific divisions. One [PMC](#) may be hired for Area Based Development (ABD) and another for *Pan City Projects* (PCP), or one [PMC](#) for civil infrastructure and another for digital projects, or a consortium of multiple [PMCs](#) may be created. In the case of the first model, the overall responsibility of ideation, planning, and monitoring of the [ABD](#) projects tends to lie with the [PCP PMC](#), while construction of [ABD](#) infrastructure lies with the respective [PMC](#).

The [PMC](#) is led by a Team Manager who coordinates between different [PMC](#) teams such as town planning, e-governance, traffic systems, and transport. Each team develops a particular solution that was proposed in the city's proposal. The [PMC](#) managers coordinate with the [SPV](#) managers to develop or modify projects based on the contracts signed between them. While the contracts fulfil the proposal, some modifications are carried out based on advice from advisory committees (identified below) or changing circumstances such as natural disasters or the COVID-19 pandemic. The [PMC](#) coordinates with other municipal agencies through the [SPV](#) managers, for example, public transport solutions require coordination with transport agencies and the traffic police. While the solutions are ideated and developed by the [PMC](#), the implementation of the solution, i.e., the digital intervention, whether a platform, an app, or an [IoT](#) device, can be done in two ways – through a *Master System Integrator* (MSI) or through an *Implementing Agency*.

⁷ The [Smart Cities Fellowship](#) was instituted in 2019 and invites teams of young students and researchers to create solutions for the [SCM](#). Each team is mentored by [NIUA](#) and industry experts to create projects to solve specific urban problems. The [NUDM fellowship](#) was also launched along similar lines in 2022.

Figure 2: Generic illustration of SPV organizations for digital interventions.



The MSI is generally a firm hired by the SPV and is subordinate to the PMC. The MSI is responsible for initiating projects as per the directive of the PMC. Based on the solutions developed by the PMC, and in line with technical requirements, the MSI hires vendors for specific products. For instance, a traffic management solution requires sensors to capture traffic violations, cameras to take photos of number plates, and software platforms that use algorithms to change traffic signals, process number plates to text, and issue e-challans. The MSI is responsible for obtaining cameras according to specifications, sensors that can capture violations, and programs that are able to process the data from these. Accordingly, it identifies vendors who provide these as individual components. The MSI then integrates the components into a functional system based on the architecture provided in the solution by the PMC. The second level of integration is across multiple solutions – the MSI is responsible to ensure that all solutions in the city can be integrated into a central platform which can be monitored from the ICCC.

Vendors contracted by the MSI can range from sensor hardware companies to web developers,

app developers, GIS platforms, and programmers. The responsibility of ensuring the compatibility of platforms, sensors, apps, and data formats lies with the MSI and is included in the RFP and the contracts signed with the vendors. In another model of implementation, the PMC hires one *Implementing Agency* (IA) for each specific project. An IA may be hired for traffic solutions, and therefore is responsible for acquiring sensors, cameras, software, and delivering the entire traffic solution as one package to the SPV where the PMC integrates it with existing systems.

Within the hierarchy of the SPV lies the position of the CDO, as proposed in DSCS. The CDO position is generally not appointed from municipal agencies, state cadres, or PMC but is a technical expert appointed by the SPV. The CDO performs a technocratic function of ensuring that SPV or municipal requirements are fulfilled by the PMC and the MSI. The CDO is also responsible for day-to-day coordination between SPV managers, PMC, MSI, and vendors. While the coordination of the SPV with state or central agencies lies with the CEO and the managerial staff, the CDO is responsible for coordinating and fulfilling all technology and data-related requirements

of [MOHUA](#), [NIUA](#), [SCMMU](#), and DAMU and updating datasets to the [IUDX](#), and other portals. The [CDO](#) is also responsible for creating the City Data Policy (CDP) and maintaining the data servers of the [SPV](#). As illustrated in Figure 2 above, the [CDO](#) bridges the administrative and consultant divisions of the [SPV](#).

The [CDO](#) is guided by two committees, the *City Data Alliance* (CDA) and the *Smart Cities Advisory Forum* (SCAF) which are introduced in the [DSCS](#). As identified above, the [CDA](#) is supposed to be composed of stakeholders from citizens, academia, industry, and municipal agencies and apart from advisory functions, it has to suggest changes to the [CDP](#), work towards data awareness in the city, develop data use cases, and create collaborations between multiple public and

private agencies to develop data infrastructures and solutions. The SCAF was constituted as a “City Level Advisory Forum” by a [MOHUA](#) Office Memorandum in 2016 and would include elected representatives, the CEO of the [SPV](#), the Mayor of the city, youth members, NGO members, and technical experts. The [DMAF](#) Cycle II evaluations and our field interviews have suggested that there are shortcomings in organization or functioning of the [CDA](#), and documentation on SCAF meetings is not available for most cities.

While the [SCMMU](#) was created quite early in the [SCM](#), all other central units, programs, and platforms within the [NIUA](#), and city-specific positions like [CDO](#), and [CDA](#) were developed only after the [DSCS](#) guidelines were issued.

4. MANAGING DIGITALIZATION – PLATFORMS OF THE [SCM](#)

Despite the large number of platforms created as a part of the [SCM](#), they are not clearly imagined or elaborated in either the *Guidelines* or the [DSCS](#) and [NUIS](#). In fact, they may sometimes be implemented in practice without a documentary origin. Platforms are substantially defined and suggested in multiple ways in the [DSCS](#) – “city-as-platform” ([MOHUA](#) 2018a: 4), “technology platforms to support implementation of policy” (ibid: 5), “open data platforms” (ibid: 5), “platforms for...data analysis and management tools” (ibid: 12). In this section we elaborate the multiple platforms created for the [SCM](#), either through the [DSCS](#), [NUIS](#) or other initiatives.

We identify three broad categories of platforms – first, centralized platforms which guide cities and other agencies through information and networks about [SCM](#), NUDM or assist in digitalization practices; second, national platforms which consolidate data from cities for exchange with other cities and other stakeholders, or aggregate data for analysis; and third, platforms at the city level which acquire data from sensors and other agencies, or platforms that offer services to citizens. We provide an illustration from each of these categories, while details on others can be found in the appendix.

Guidance Platform - *Smartnet*

Smartnet is a guidance and solutions platform of the [MOHUA](#) and is hosted by [NIUA](#). Smartnet is supposed to provide learning and knowledge tools not only related to the [SCM](#) and NUDM, but also other schemes such as AMRUT, HRIDAY, and Swacch Bharat. As a platform, it aims to connect cities, researchers, and technologists and encourages linkages between governments and businesses. Smartnet is aimed at hosting training programs, tender documentation, and highlighting best practices. In addition, it is supposed to display updates on the progress of Smart Cities and their financial and physical progress through dashboards. It also claims to be a platform for industries to display solutions and innovations that cities can use. To summarize, Smartnet is an open repository that aims to provide training to cities, allow showcase by industry, host documentation and finally chart the progress of digitalization and [SCM](#) implementation.

Smartnet hosts a webinar series, training videos, and documentation for ICCD, apart from showcasing city planning initiatives for traffic, mobility, and neighbourhood improvement. The platform also hosts

discrete sections – a page with all [MOHUA](#) projects and missions; learning tools; contributing to the platform; connecting businesses, practitioners, and cities; and advertising opportunities. Smartnet also provides learning tools that include two components – a documentation library of case studies, research papers, reports, and guidelines; and second, a library of videos made by cities and the [NIUA](#), full course MOOCs developed by external sources such as the World Bank and Coursera, and single video MOOCs sourced from YouTube. It is unclear how many of these documents or videos have been downloaded, viewed, or used by [SPV](#) staff. There is also a product gallery for industry actors to showcase technology solutions, and the products on the platform range from cybersecurity solutions to drones to citizen engagement platforms. It is unclear if any of these solutions have been utilized by cities.

What Smartnet effectively does is to connect multiple initiatives under the [SCM](#), NUDM, and other [MOHUA](#) projects in one location. Smartnet is not limited to the [SCM](#) but is potentially available as a resource platform for any [ULB](#) to obtain training or information (although we have found no sources that indicate its actual use when it comes to education and training). However, since it does host most documentation and resources available for [SCM](#) and NUDM, this becomes a central repository to locate most digitalization frameworks and strategies.

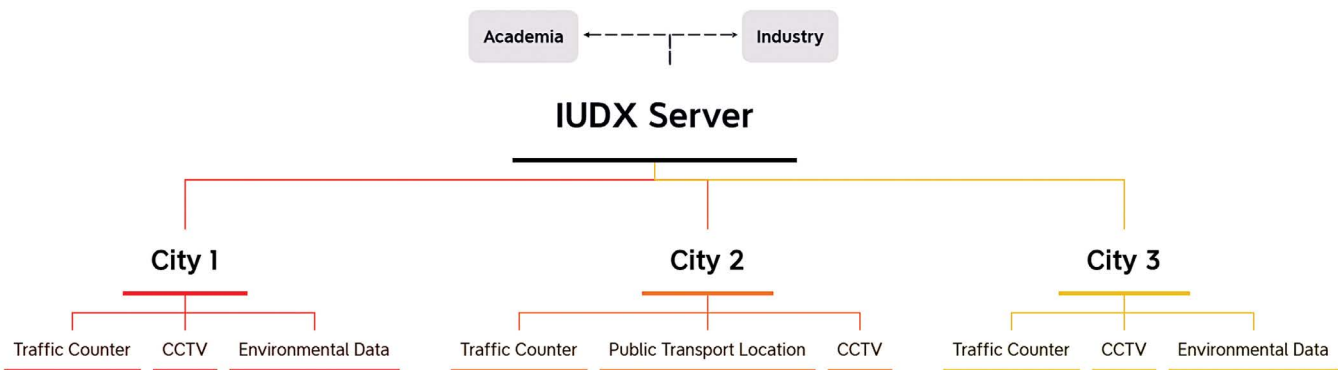
Data Acquisition and Exchange – India Urban Data Exchange

The key push toward data acquisition, analysis, and solutions was not clearly visible in the [SCM](#) documents, but as described above received a significant push from the [DSCS](#) supplements and got another push with the launch of the NUDM. While some smart cities were already producing data through various initiatives, the utilization of this data depended on the [SPV](#). The [DSCS](#) envisions data to be exchanged, analysed and marketed, requiring specific platforms for these. The [IUDX](#) platform is suggested by the [DSCS](#) and is currently functional.

The [IUDX](#) was designed to acquire and consolidate data and function as a data exchange and marketplace. The platform went through two iterations before it was formally launched in 2021. The final platform was originally deployed for ten cities as a pilot study and since then has expanded to 26 cities. The limited number of cities is explained by non-standard data, inefficient collection practices, or lack of [SPV](#)-level technical capacities (Interview [IUDX](#) 2022). It is imagined that all cities ([SCM](#) and otherwise) can centrally house their data in the [IUDX](#).

[IUDX](#) can access real-time data directly from city-level sensors and platforms and aggregate this centrally.

Figure 3: Movement of data from cities to [IUDX](#)





Datasets uploaded on the platform are labelled as public or private access by the [SPV](#). Anyone can access data hosted on the platform through [APIs](#), depending on the user license and the data label. Environmental data from most cities is available for public access, while transport and municipal services data have been marked as private access. The [IUDX](#) thus functions as a data broker, centralizing data from cities and making it available to users. The [IUDX](#) also aims to have an inbuilt analytical tool ([IUDX++](#)), but this has not yet been fully implemented.

The [IUDX](#) suggests use cases for solutions from data analytics. As a marketplace, it has made data from more than three cities available to consultancy and technology firms to develop digital solutions for the management of waste, transport, and public safety. Cities have the agency to decide if they allow these firms to access data through the [IUDX](#) and issue appropriate licenses accordingly.

The [IUDX](#) imagines the use of data to create open innovation, creating open solutions that can be available to cities through platforms. As [SCM](#) projects are rolled out, and sensors are deployed, a variety of urban data is being collected in multiple formats. Since each smart city has its own specific tools and sensors, the data from these is acquired and stored at the city or state databases in different industry formats. While cities are producing vast data sets, these are not necessarily available to the [SPV](#) or the municipal institutions and are sometimes still being monitored by [PMCs](#).

There is no common pattern in the storage of data sets – some records may date back six months, others may be only for a few weeks. Some of this data comes from sensor infrastructure, while others come from municipal records on services consumption or citizen certificates. Keeping this in mind, availing data from across cities for analytics or solutions requires an exercise in standardization. The [IUDX](#) has worked towards this standardization of data with the Bureau of Indian Standards and industry experts across the previous two versions of the platform. For the platform to function efficiently, and to imagine that it aggregates data from all sensors of all cities, it needs to ensure all cities utilize a common standard.

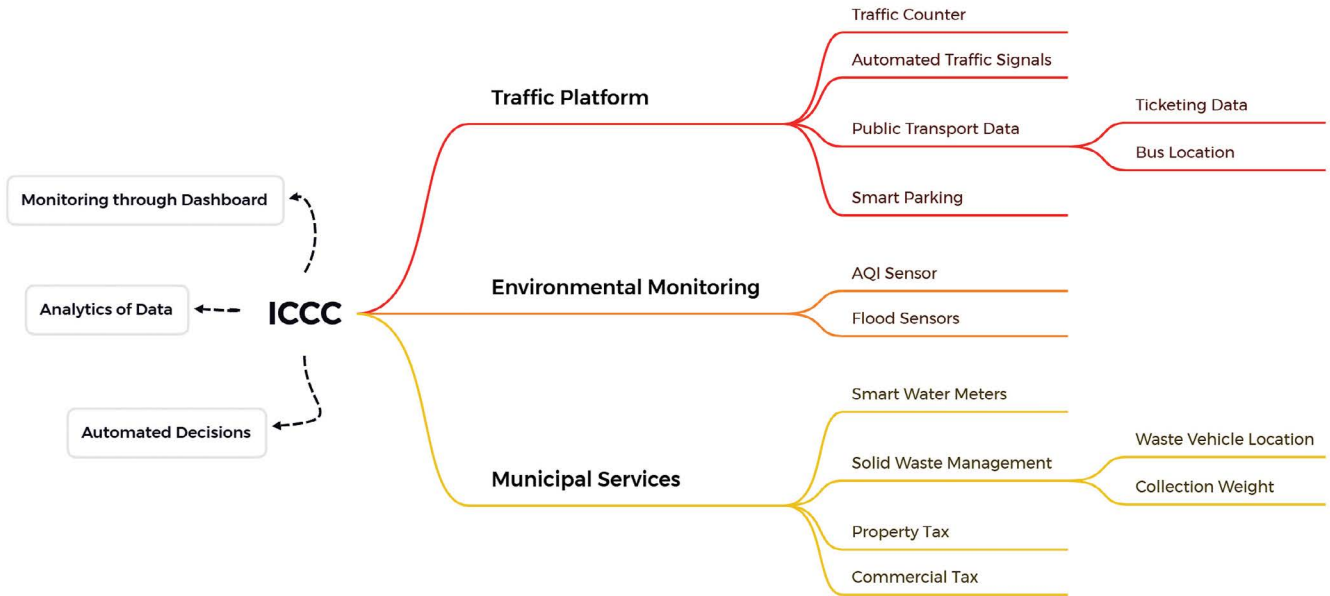
City-level Data Acquisition and Analytics – Integrated Command and Control Centre

While the platforms detailed above are developed or implemented by central agencies, cities use their own platforms under the [SCM](#). In this section, we illustrate the most visible platform used by cities – the Integrated Command and Control Centre (ICCC).

The ICCC is one of the key projects of most cities under the [SCM](#). The ICCC is modelled after Rio de Janeiro's *Centre of Operations* (Praharaj 2020), which could coordinate multiple municipal agencies' functions and operations, and monitor services, transportation, weather, and emergencies. Most [SCM](#) cities have developed and established an ICCC in offices of the [SPV](#). ICCCs have a common architecture – giant screens that display information from cameras, sensors, and apps; with banks of computer terminals where specific teams monitor specific domains. All sensors deployed in the field are synced with the ICCC, and all data from these sensors is accessible centrally. Subsidiary platforms (such as traffic management systems and public address systems) are monitored and utilized from the ICCC which syncs with agencies such as the Police Commissionerate. Some ICCCs have connected sensors and city-level information with GIS systems, allowing for organizing, displaying, and analysing data spatially. Some ICCCs also double as call centres for grievance redressal, and during the Covid-19 pandemic were fashioned into “war-rooms” – spaces where city-wide agencies could work together to monitor cases, deploy health or police personnel, and track disease spread spatially. Some examples of the ICCC for health monitoring can be found [here](#).

While ICCCs are capable of reading data from multiple sensors and sources, they require a system or “engine” to aggregate and compare this data to derive analytical solutions. There are multiple vendors who have provided these analytics engines – while ESRI is largely focused on spatial analytics, IBM's *Intelligent Operations Centre for Smarter Cities*, Cisco *Kinetics for Cities* (CKC), and Quantela's eponymous platform (formerly known as Atlantis) have broader capabilities. The CKC and Quantela platforms have been deployed in multiple ICCCs in [SCM](#) cities. Following is a description of how these platforms work, using the example of CKC.

Figure 4: Generic model of ICCC



The CKC is a platform that integrates all Smart City tools, sensors, and data in order to analyse, automate, and regulate services. Any data obtained through sensors are fed into the CKC – the movement of public transport, number of tickets sold electronically, the weight of waste collected by vehicles, the status of streetlights on smart poles, number of parking spots used or open, climate and pollution data, build-up of traffic in junctions – depending which sensors are installed by the city. Some of this data can be used for automation, for instance, CKC can automatically send alerts to municipal engineers if streetlights fitted with sensors indicate that a bulb is faulty. The second functionality can be understood in terms of real-time analytics, where the CKC can change traffic signals based on changing traffic flows or deploy waste collection trucks on specific routes based on waste collection data. The CKC can also combine data

from multiple sensors and trigger specific systems to create a solution – using data from traffic sensors and public transport ticketing to re-route traffic via public messaging boards and create faster corridors.

In field studies of two cities where these platforms were deployed, it was observed that while the platforms are used to monitor and gather data from multiple sources, the analytical capacities of these platforms are only in the planning stages and not yet implemented. Additionally, data practices are not uniform – traffic data may be stored for a couple of months, while environmental data may be deleted every week. The implementation of these solutions also requires coordination between multiple city agencies. At this stage, it is unclear who can obtain the data from the ICCC and who will implement automation. Currently, in most cases, the ICCC is monitored by the [CDO](#), the [PMC](#) team, or the MSI team.

5. DISCUSSION

This working paper attempts to perform a broad survey of the transformations in policy and practice under the Smart Cities Mission, many of which carry forward into the National Urban Digital Mission. The NUDM has already started rolling out various platforms for municipal governance through the [CDC](#) and implemented various datafication strategies, long before the dust around the [SCM](#) has settled. For instance, a single open-source platform for citizens' service delivery (UPYOG or DIGIT) has been implemented in [ULBs](#) by at least twelve states and replaces multiple platforms developed under older projects.

Despite the detailed breakdown of documents, institutions, and processes above, this is in no way an exhaustive documentary of the practical elements in the digitalization of urban governance in India. Based on the above review, we make the following observations and establish the direction of our future work.

The supplementary policy documents issued by the [MOHUA](#) attempt to *standardize digitalization*. The [DSCS](#) suggested administrative structures to roll out digitalization, the [NUIS](#) provided the design and architecture for platforms, while the Smart City Standards created technical standards for the implementation of technology. Together, these lead to two forms of standardized digitalization – standardization of specific technologies to be used by cities, and standardization of data acquisition and sharing. It is necessary to understand how this standardization will pan out in the long term, and what are the ends for the acquisition of Big Urban Data sets.

Another standardization is the creation of technocracies involved at the [SPV](#) level. While each city has varied hierarchies and institutional structures, the [DSCS](#) and [NUIS](#) regulate the position of the [CDO](#), who works as a liaison between [SPV](#), [PMC](#), Municipality, State, and National agencies. In our early fieldwork, we observed that despite clear roles and functions defined in the policy, [CDOs](#) face multiple institutional and technological challenges. This is bolstered by the [DMAF](#) Cycle II reports which show scattered scores for the implementation of digitalization by the [CDOs](#). As part of an ongoing study, we combine [DMAF](#) reporting with qualitative interviews and analysis to understand the dynamics of the [CDO](#) position within [SCM](#) cities.

Apart from the [DMAF](#), it is not understood how cities are utilizing data or implementing digital tools. It is unclear what happens to the data and the technology in the long term, in case the [SPV](#) is dissolved. It is also unclear how city institutions like the municipality and development authorities will utilize the digital tools and data sets that have been created under the [SPV](#).

The role of the private sector requires a closer look. Who are the actors drafting these policies and designing these digitalization architectures at the ideation level? How do these relate to global smart city policies and interventions? At the implementation level, what are the internal knowledge structures that have been created among firms to share learnings and practices to further entrench themselves as smart city/ urban digitalization experts? It is necessary to understand why specific firms and organizations are at the forefront of digitalization policies, strategies, and solutions as identified above.

The [SCM](#) encouraged cities to create their own proposals and hire consultants through the [SPV](#) to implement projects – this led to the deployment of multiple proprietary apps and platforms within the city. Currently, most of these apps and platforms are still monitored and managed by the [PMC](#) or the MSI, and the functioning or data from these have not been fully handed over to the [SPV](#) or municipal agencies. This also implies that the integration of city data with platforms like [IUDX](#) is not fully feasible at this stage. We intend to trace how [IUDX](#), DIGIT, ICCC, and other platforms can possibly integrate into a functional data acquisition and how these will alter future digitalization pathways.

While we have focused on the terrain of digitalization of urban governance in this report – a vast, complex, and growing area of urban policy – it is important to keep in mind that this exists in a wider arena of urban policy and development. Contextualizing digitalization within the larger urban policy in India will raise its own set of questions, contradictions, and structural and material hierarchies. Research that focuses more closely on “actually existing” urban digitalization could consider the implications of this on citizens and how they interact with the city.



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APPENDIX

In the main text of this paper, we were keen to present an overview of urban digitalisation in India, particularly in the current moment under the Smart Cities Mission. The numerous documents that we have referred to and summarised have played a significant role in this digitisation process by setting out strategies, introducing new roles and institutions, and initiating the set-up of a number of digital platforms.

In this appendix, we provide links to the various documents and platforms that have emerged under the Smart Cities Mission. At the same time, for brevity, we have not included the multiple documents or platforms in the main text. Not all interventions have come to fruition; however, here we attempt to create a repository of documents and websites linked to the [SCM](#).

Key Websites

- Ministry of Housing and Urban Affairs (MOHUA): <https://mohua.gov.in/>
- Smart Cities Mission Website: <https://smartcities.gov.in/>
- DataSmart Cities Website: <https://dsc.smartcities.gov.in/>
- National Institute of Urban Affairs (NIUA): <https://niua.in/>

Policy Documents

■ [Mission Guidelines \(2015\)](#)

The Mission Guidelines signalled the launch of the Smart Cities Mission and laid out the operational details of the Mission, including the governance structure, financing, and accountability measures. In addition to this, the Guidelines outlined what interventions cities should introduce and the aspects that should be included in their smart city proposals ([SCP](#)).

■ [DataSmart Cities Strategy \(DSCS\) \(2019\)](#)

The DSCS was the first document published under the [SCM](#) to focus specifically on how cities could use data to improve governance, analytics, and even profitability. The document lays out not only the importance of city-level data and analysis but also provides the foundation for policy and institutional changes that cities need to make in order to build a “data culture” and eventually make cities “data marketplaces”. The document focuses on three pillars, people, process, and platform.

■ [National Urban Innovation Stack \(NUIS\) \(2019\)](#)

Many of the platforms and interventions discussed in this paper, including in a following section of this Appendix, were first discussed in the NUIS. The document lays out the architecture for the proposed stack which would essentially allow cities to access solutions, share knowledge, and provide data through this centralized platform. It would also allow businesses to offer their services to cities. The NUIS reiterates the central role that digital technologies and data can play in urban development, which would in turn spur national economic development.

■ [Designing a City Data Policy \(2020\)](#)

The importance of having a city data policy was first underscored by the [DSCS](#). This document guides cities through designing their data policies, outlining why such a policy is important, what cities should include in their policies, data practices to be initiated, and data protections to have in place. The document also includes a model city data policy that cities could use as a template.

■ **City Data Alliance (2022)**

This document outlines data alliances that cities could build with other stakeholders – businesses, academia, and citizens – so as to optimally use city data, encourage innovation, and spur urban development. The document outlines the advantages of alliances, how the government could approach building such alliances, and provides examples of successful alliances from Indian cities and from cities around the world. Finally, the document provides a draft Memorandum of Understanding (MoU) that cities can use.

Assessment Frameworks

■ **Data Maturity Assessment Framework (DMAF) (2019)**

Closely linked to the [DSCS](#), the DMAF attempts to measure the progress cities are making toward becoming data smart. The DMAF encourages cities to focus on two aspects—data as a process and data for achieving outcomes. In terms of measurement, the Framework focuses on “systemic maturity” and “sectoral maturity”, each of which has its own indicators.

■ **ICCC Maturity Assessment Framework (IMAF) (2021)**

Like the [DMAF](#) measures a city’s data smartness, the IMAF measures its technological progress. The IMAF outlines some of the municipal and non-municipal services that an ICCC can offer like city infrastructure management, civic services monitoring, traffic and transport management, safety and surveillance, and disaster management. The functioning of the ICCC itself is measured along four capabilities—functional capability, technological capability, operational capability, and engagement capability.

■ **Smart City Standards (2022)**

The Smart City Standards are a collection of standards that provide technical guidelines to cities for their digital interventions.

Platforms

■ **Open Data Portal**

Similar to the country-wide open data website, the Open Data Portal has been developed for the 100 smart cities to upload various data sets to. As the name suggests, these data sets are accessible to anybody who would like to see or download them. Each of the 100 cities has uploaded at least one data set however some cities have been far more proactive than the others. Most data uploaded on this portal is not of good quality or standardized. This was the earlier iteration of the [IUDX](#).

■ **IUDX**

The India Urban Data Exchange (IUDX) is a platform through which cities can access and share data while maintaining data standards and security. Apart from [ULBs](#) and their various departments, the IUDX is envisioned as a platform that will also be useful for non-state actors like academia, industry, and civil society ([MOHUA 2018b: 43](#)). According to the [MOHUA](#)’s plan as laid out in the [NUIS](#), the data on the IUDX platform will come from a variety of sources, from [IoT](#) sensors, demographic data, tax and property records, as well as historical data which will be digitized.

■ [India Urban Observatory \(IUO\)](#)

The India Urban Observatory has been set up by the Ministry of Housing and Urban Affairs (MOHUA) in partnership with a number of other organisations, including Cisco, Amazon Web Services, the [NIUA](#), and CEPT University. Its primary function is data visualization, providing interactive maps and resources, use cases, and suggestions on how data can be presented in various forms to provide information and insights. The IUO has created visualizations using data from the global, national, state, and city levels.

■ **Smartnet**

Smartnet acts as a repository of resources for cities. The website links to a number of the platforms mentioned here, provides access to policy documents, and acts as a learning sharing and knowledge platform for urban stakeholders. As per the website, Smartnet is not only for [SCM](#) cities but for cities across the country including those under other policies like Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and National Heritage City Development and Augmentation Yojana (HRIDAY). Furthermore, Smartnet offers membership to stakeholders from government, businesses, and academia. As a platform, Smartnet also shares details on conferences, tenders that have been floated, RFIs, etc.

■ [National Urban Learning Platform \(NULP\)](#)

The National Urban Learning Platform (NULP) has been imagined to give city officials the opportunity to keep their knowledge and skills up-to-date. Officials can access a variety of courses, workshops, training, and skill-building from all over the world through this platform. In order to ensure that city officials are building the capabilities they find most relevant, the NULP is supposed to tailor its programming according to what cities need. Finally, it is suggested that courses will be certified in order to increase incentives and to make the skills gained transferable. In a section below we detail the content available on the NULP, and its utilization.

■ [City Innovation Exchange](#)

City Innovation Exchange is envisioned as a networking site wherein city governments can share their challenges and invite feedback or solutions through the platform itself. The platform is expected to be data-driven and a repository of stakeholders that cities can connect with for various interventions. Experts can, on the other hand, use the platform to publish or showcase their research, expertise, and interventions.

■ [SmartCode](#)

SmartCode is a program that aims to address the software needs of Indian cities by opening up the field to more software developers. It suggests that developer firms and start-ups can register on the platform as long as they meet certain basic requirements and standards. Cities can then approach SmartCode and submit their problem statements, explain their existing infrastructure, and share data if necessary. The National Urban Innovation Hub (NUIH) is in charge of putting these cities in touch with relevant developers to create solutions.

■ **Research and Innovation for Urban India**

This program builds on the concept of the city itself as a living laboratory—however, in the case of Indian cities, one whose potential has not been explored or adequately tapped into. The [NUIS](#) proposes to float “problem statements” ([MOHUA 2018b](#): 58) and invite academic institutions, industry, and start-ups to find solutions to these problems. The [NUIS](#) promises to provide data, mentorship, and even incubation to viable ideas and pilot projects. Through this platform, actors are

encouraged to collaborate and cities are encouraged to form networks. The knowledge produced would be added to the [NIUS](#)'s repository and could be used in the future. The Research and Innovation program proposes to work with other policies like Startup India, Digital India, and the Atal Innovation Mission ([MOHUA](#) 2018b: 60). While we have found incubator labs in many cities, the solutions developed within these are entrepreneurial initiatives that are not connected to solving problems of urban governance.

Bodies/ Institutions/ People

■ **Data Analytics and Management Unit (DAM Unit)**

The DAM Unit was first described under the [DSCS](#). It lends support to the Mission Data Officer and is made up of various experts from legal to policy, data analytics, and communications. The DAM Unit is also expected to support cities by providing implementation and hand-holding support, coordination of strategy implementation, reviewing progress, and adjusting the strategy accordingly. According to the [DSCS](#), the “DAM Unit cell would be the backbone for implementation of the strategy at the national level” ([MOHUA](#) 2018a: 34).


■ **[Centre for Digital Governance \(CDG\)](#)**


Initiated by the [NIUA](#), the CDG is an attempt to consolidate all the digital projects introduced by the Ministry of Housing and Urban Affairs (MOHUA). These include a number of interventions discussed above like the NIUS, and the [NULP](#). Other initiatives mentioned on the website include creating model policies and frameworks for digital governance, provide public digital infrastructure and advisory services to cities and states.




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