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DOCTORAL THESIS

One hundred smart cities: developing an urban design perspective for smart cities in India

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ONE HUNDRED SMART CITIES: DEVELOPING AN URBAN DESIGN PERSPECTIVE FOR SMART CITIES IN INDIA

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ABSTRACT

The concept of smart cities, with technology at its forefront, has gained serious traction in the last decade. Using data-driven technological tools, its promise to negate the troubles of urban living and improve city functioning has enticed a number of national and city governments to adopt smart city initiatives to future proof cities. The smart city model is considered an obscure concept by many scholars; however, evidence from research suggests that it is a versatile model that can attune the level of ‘smartness’ visualised by each city or nation. Nonetheless, the headlong drive for smart cities is placing a far greater emphasis on superficial technological overlays, ignoring the critical perspective of ‘place’-based design. This research is concerned with exploring the role of urban design perspectives in a smart city, emphasising the need for ‘place’ based design approach within the smart city model. As a focus for investigating the necessity for urban design approach in smart cities, this study examines the urban design proposals within the smart city proposals of Indian cities.

Launched in 2015, India’s Smart Cities Mission (SCM) is an ambitious attempt to use the smart cities platform to rejuvenate India’s urban landscape. Unlike its developed counterparts, developing Indian cities are still grappling with several structural, infrastructural, and governance deficiencies, with urban design constituting a missing element in the city building process. This research contributes to a broad understanding of the lack of guidelines for the ‘place’ dimension within the smart city model. Though there is a realisation of the need for well-designed spaces within the SCM of India, there is a lack of mandate and systematic approach to achieving this outcome. The thesis attempts to understand the barriers and challenges to mainstreaming an urban design approach at the national level and a local contextual level. In order to understand this, a mixed-method approach was designed based on the theoretical perspective of empirical interpretivism. The methods included desktop research of policy documents, smart city proposals, the case study of two Indian cities and semi-structured interviews with professionals and key-informants involved with the smart city development process in Indian cities.

The research highlights the gap in acknowledging urban design as an essential dimension within the smart city model. The findings conclude that the institutional capacity for urban design approach is still tenuous in developing countries like India. A national-level urban design policy guideline that is supported by contextual city-level guidelines is an important consideration in addressing the current challenges of Indian cities. An integrated model for smart cities with urban design as a unifying contributor is essential to achieving smart cities. The study finally proposes conceptual urban design guidelines for achieving well-designed smart cities in India, which may also be relevant to other similar developing and less developed countries representing the emerging economies of the global South.

Keywords

Smart cities Mission; India; Urban design; Urban planning; Chennai; Coimbatore

Declaration by Author

This thesis is submitted to Bond University in fulfilment of the requirement of the degree of Doctor of Philosophy.

This thesis represents my own original work towards this research degree and contains no material that has previously been submitted for a degree or diploma at this University or any other institution, except where due acknowledgement is made.

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Research Outputs

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Chandrasekar, K. S., Bajracharya, B., & O'Hare, D. (2016). A comparative analysis of smart city initiatives by China and India- Lessons for India. *Smart Cities for 21st Century Australia - How Urban Design Innovation Can Change Our Cities*, 339–357. Canberra, Australia: International Urban Design Conference.

Ethics Declaration

The research associated with this thesis received ethics approval from the Bond University Human Research Ethics Committee. The ethics application number is 0000016044.

Copyright Declaration

No published manuscripts were included for publication with this thesis.

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AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BBMP	Bruhat Bengaluru Mahanagara Palike
BIAAPA	Bengaluru International Airport Area Planning Authority
BREEAM	Building Research Establishment Environmental Assessment Method
CABE	Commission for Architecture and the Built Environment
CBD	Central Business District
CCMC	Coimbatore City Municipal Corporation
CCTV	Closed Circuit Tele Vision
CMA	Chennai Metropolitan Area
CMDA	Chennai Metropolitan Development Authority
CMRL	Chennai Metro Rail Project
CRRT	Chennai Rivers Restoration Trust
CSR	Corporate Social Responsibility
CUMTA	Chennai Unified Metropolitan Transport Authority
CWC	Central Water Commission
DDP	Detailed development plan
DMIC	Delhi-Mumbai industrial corridor
DSIR	Dholera Special Investment Region
DTCP	Directorate of Town and Country Planning
DUAC	Delhi Urban Arts Commission
ECR	East Coast Road
EU	European Union
FAR	Floor Area Ratio
FPZ	Flood Plain Zoning
FSI	Floor Space Index
GDP	Gross Domestic Produce
GHG	Green House Gas
GIFT City	Gujarat International Finance Tec-city
GMCA	Greater Manchester Combined Authority
GOI	Government of India
GPS	Global Positioning System
HUDCO	Housing and Urban Development Corporation
ICT	Information communication technology
IDSMT	Integrated Development of Small and Medium Towns
IHSDP	Integrated Housing and Slum Development Programme
INTACH	Indian National Trust for Art and Cultural Heritage
ISO	The International Organisation for Standardization
IT	Information Technology
JNNURM	Jawaharlal Nehru National Urban Renewal Mission

LEED	Leadership in Energy and Environmental Design
LPA	Local Planning Authority
MAN	Metropolitan Area Networks
MFP	Multifunction Polis
MLD	Millions of litres per Day
MRTS	Metro Rail Transport System
MSV	Multimedia Super Corridor
MTC	Metropolitan Transport Corporation
NAMP	National Air Quality Monitoring Programme
NGT	National Green Tribunal of India
NITI AAYOG	National Institute for Transforming India
NRY	Nehru Rozgar Yojana
NSA	National Security Agency
NSDP	National Slum Development Programme
OMR	Old Mahabalipuram Road
OVGA	Office of the Victorian Government Architect
PMIUPEP	Prime Minister's Integrated Urban Poverty Eradication Programme
PPP	Public-Private Partnerships
PWD	Public Works Department
RAY	Rajiv Awas Yojana
RFID	Radio Frequency Identification
SCK	Smart City Kochi
SCM	Smart Cities Mission
SEZ	Special Economic Zones
SIMA	Southern India Mills Association
SIR	Special Investment Region
SJSRY	Swarna Jayanti Shahari Rozgar Yojana
SPV	Special Purpose Vehicle
STAR	Communities rating
TNPCB	Tamil Nadu Pollution Control Board
TNSCB	Tamil Nadu Slum Clearance Board
UBSP	Urban Basic Services for the Poor
UDF	Urban Design Framework
UDPFI	Urban Development
UHI	Urban Heat Island
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
UK	United Kingdom
ULB	Urban Local Bodies
UN	United Nations
UNESCO	The United Nations Educational Scientific and Cultural Organization

USA	United States of America
USD	United States of America Dollar
VAMBAY	Valmiki Ambedkar Awas Yojana
WCCD	World Council on City Data

CHAPTER 1

INTRODUCTION

Improving mobile technology, combined with real-time sensing, is enabling seamless access that is changing the way citizens inhabit contemporary cities. There is a widespread phenomenon of increasing smart city experiments and implementation through leadership at a city level and the broader national level. However, in their swiftness to negotiate urban problems using instant technological solutions as enhancements, most city governments ignore how urban spaces are transformed without due consideration towards retaining or enhancing the 'sense of place' value in cities. This thesis explores the need for an urban design perspective in smart cities. The study investigates the smart city transformation in Indian cities with specific reference to the role of urban design in this process.

1.1 Background of the research

Though delving into the matter of urban growth projections is a highly clichéd starting point for most contemporary urban studies, it is a stark reality that most city regions attract population and grow exponentially over time. The global community is still grappling with city labels and concepts that may lead us towards a perfect "Utopian City" from the present dystopia. A number of cities have failed in terms of planning and infrastructure, lack of social cohesion, failure to achieve balance with the environment and an unfulfilled promise on 'improved quality of life' (a very abstract term). Despite these failures, human fascination for science fiction, automation, robotics, and other machine-based technology as a means to address these challenges have continued to proliferate. The exponential growth of smartphone technology and cloud computing, now accessible at a more personal level, has contributed to the sustenance of this technological fascination for humans (Townsend, 2014). The continued rise of smart city model is possibly a direct outcome of the allure for technology.

Based on technological reliance, the current push is to move away from 'dumb' cities towards 'smart' cities, which could facilitate the seamless flow between all facets of our lives. Glasmeier and Christopherson (2015) comment on this notion as an evolution from the long-held desire for urban technological utopias and to live in a perfectly competitive city. Smart Cities are recipients of this technology and its applications, for fostering meaningful urban transformation. Different stakeholders appear to be interested in different aspects of smart cities. While businesses see the market potential, academics are keen to investigate the ability of the technology to sense and track the use of urban infrastructure in smart cities. Philanthropists might look for opportunities for citizen empowerment and quality of life, while politicians as the next 'big idea' (Glasmeier and Christopherson, 2015). Though for each, their respective outcomes are crucial, it is clear that smart cities, possibly unintentionally, have reignited the thinking behind cities as engines of growth. The expectations on the smart cities model to deliver the blueprint for the long-awaited technological utopia needs review in future.

The growing aspiration towards a wholly digital environment has resulted in an almost diminishing line between 'real' and 'virtual' existences. The embedded nature of information communication technology (ICT), the presence of Wi-Fi nodes, and mobile technology, along with its wearable extensions, are all reducing this distinction even further. However, as Alessandro Aurigi in the foreword of the conference proceedings "Enhancing places through technology" (Zammit and Kenna, 2016) points out, ignoring the physical world in a smart city by focusing predominantly on the digital aspects is a real issue. He argues that a very linear and simplistic approach towards a tech-first or tech-only perspective is often spurred by technological determinism that engages only in matters related to the socio-economic and political sides of urban development, leaves behind the physical space. Kourtit et al. (2012) express how contemporary cities have shifted from their intent of creating the feeling of *'sense of place'* in cities towards being '*place of senses*'. Urban design plays a vital role in establishing the 'sense of place' at a square, street, neighbourhood, district, and city level. The re-evaluation of urban space within the sphere of smart cities is, therefore, essential for re-establishing the physical space. This research is concerned with these assertions and focuses on the requirement of an urban design perspective in contemporary Indian cities on their smart cities' journey.

1.2 Problem Statement

The advent of this new age of digital technology in the current century creates innumerable opportunities for cities. The real-time functioning of the cities could be better understood using various sensing technologies and data analytics tools. Likewise, the increasing propagation of smartphones that enable 'anywhere, anyplace' access to information through the mobile network has changed the way citizens access city services. The handheld platforms assist in data gathering that is useful to policymakers in formulating a long-term strategic vision for the city. However, it is complicated for city governments to estimate the real value as economic returns, value to citizens, implications on organisational structure, operational needs, and how investments into urban technology will fit within the sphere of political and governmental strategies (Cosgrave et al., 2014).

Smart Cities have struck a chord with city administrators in local governments and national administrators around the world, which is reflected by the burgeoning number of smart cities projects proposed (Rodriguez-Bolivar, 2015). Economically and technologically advanced nations like United States, United Kingdom, Australia (Ravi et al., 2016), and numerous European countries (Manville et al., 2013) have all been experimenting with smart cities technology and solutions. Han and Hawken, (2018) identify that in recent years emerging economies such as China, India and Nigeria have joined the 'smart city' boom. The Government of India (GOI) allocated USD 1.2 billion in budget 2014-15 as a seed fund for the development of 100 smart cities in India (Hemani and Das, 2015). Countries like the United States pledged to contribute in terms of capital and global expertise to improve the cities of Aurangabad, Ajmer, and Visakhapatnam (Anand, 2015).Similarly, Germany has committed to partner with Kochi, Bhubaneshwar and Coimbatore (BMI, 2018) . India's smart city initiative is thus receiving global attention with the potential to assist the global economy in its slow recovery from the 2008 economic crisis.

Many city governments are transitioning from the traditional planning process towards sustainable smart concepts (World Economic Forum, 2013). India, with an expected urban population of 800 million in 2050 from the 420 million in 2015, has an essential job in hand to progress towards the right urban pathway in the next 5-15 years (Tewari and Godfrey, 2016) and the Smart Cities Mission (SCM) has the potential to invigorate the urbanscape of chronically infrastructure-deficient Indian cities. Some common challenges found in most Indian cities include high-density urban spaces, illegal slum settlements, shortages in power supply, water, drainage, and waste management, poor infrastructure, high rural to urban migration in addition to societal issues like corruption and the presence of criminal networks (Thirumaran and Santhiya Rani, 2015). In the constant battle to rectify or overcome these challenges, urban design in modern India is more an afterthought than a conscious decision for a functional and aesthetic outcome.

Given this background, the smart cities mission has the potential to rejuvenate the state of India's cities. The research, therefore, aims to understand the current urban scenario in India's major cities along with identifying the planning challenges and constraints. Based on this, the study aims at formulating a conceptual urban design framework for the smart cities' mission, which is grounded on the research findings, to serve as a point of reference for Indian policymakers, urban designers, planners, and architects. Lack of urban design focus in Indian cities has been a concern for some time for the researcher, who was working as an architect in Chennai, India. Having practised for more than ten years, the experience of working on projects in a few South Indian cities stimulated this interest to investigate the expression of urban design in Indian cities. The vast differences in the way urban spaces were conceived, planned, and practised in the West and the different approach in Indian cities has strongly motivated the researcher to investigate further.

When it comes to smart cities, places like Songdo in South Korea and Masdar City in the United Arab Emirates are examples based on the latest expertise both in terms of technological advancement and design knowledge (Walravens, 2015). In contrast, cities that have been in existence for centuries carry with them a baggage of physical and structural issues that needs addressing while retrofitting for future needs. Most Indian cities would fit this analysis, and hence the smart cities mission requires in-depth research, there has been little or no research attention on how smart city policy could shape the urban design of a city, especially in a brownfield site. Therefore, the objectives and challenges for smart cities on a greenfield development are vastly different from smart city proposals on an existing brownfield site. These are the gaps that this research intends to address by identifying the framework for urban design that would inherently contain means to achieve not just smartness in terms of technological prowess, but also superior sustainability and inclusiveness.

The more we are connected virtually, the more we lose our connections with the traditional community. Kitchin (2015) emphasises that to make smart cities viable, academics and practitioners should engage in collaborative research on the capabilities of the technology, the conditions for applying the urban technology in terms of the city size, market and density, and the marketability of these applications. Although there is abundant literature available on smart cities encompassing both technical data and urban planning, there is a lack of India-specific studies that focus on both the urban design and planning component of the smart cities' transformation.

In this context, the purpose of this thesis is to understand the way the smart city transformation is happening in Indian cities and how this will influence its urban design, to identify the strengths and weaknesses of the evolving process, and to provide recommendations for pragmatic improvements. Several issues need to be covered, which have a direct link to the research questions. In the next section, the research questions, rationale, and aims and objectives of this research outlined.

1.3 Research Aims and Objectives

The study aims to explore the importance of urban design within the context of the smart cities' transformation in India, with a focus on delivering a conceptual framework for urban design strategies, within the smart cities model. The research seeks to address the following research questions in this connection:

Q1: How does urban design contribute to the smart city model?

Q2: What is the significance of urban design to India's smart cities mission?

Q3: What are the barriers and opportunities that affect the implementation of smart cities in India?

Q4: What should be the components of the urban design framework for Indian cities?

1.4 Research Approach

The research uses case study methods to understand the existing planning and urban design issues in Indian cities and evaluates the barriers to the implementation of smart cities. Investigation of the study areas during a field trip was both focussed on the area-based development proposals by the individual cities and an overview of the pan-city proposals. However, the overall study on the barriers and challenges focussed on the cities a whole, for a holistic perspective. More specifically, this research looked into how the 'place' based design dimension in the two South Indian cities of Chennai and Coimbatore. Based on an understanding of the outcomes, it was possible to present suitable recommendations for the implementation of smart cities to improve the quality of life in Indian cities. The research will build on previous works in the literature to formulate a conceptual urban design guideline that could enhance the urban realm in Indian cities, achievable through the Smart Cities Mission. The research plan is outlined in table 1.1, explaining the methods used to address the research questions and the sequential layout of the chapters.

Table 1.1: A detailed breakdown of the research plan

Research Aim	***To explore the importance of urban design within the context of smart cities transformation in India, with a focus on delivering a conceptual framework for urban design strategies, within the smart city model***	
Contextual background to establish the research gap		
Preliminary Objective 1: To review the concept of smart cities and to establish the importance of place-based design in a smart city	*Literature review*	*Ch.2: The Structure of Smart Cities*
Preliminary Objective 2: To investigate the state of urban planning and design in Indian cities		*Ch.3: Overview of planning and design in Indian cities*
Research Questions	***Methods***	***Chapters***
RQ.1. How does urban design contribute to the smart city model?	*Desk research and analysis*	*Ch. 5: Role of urban design in the smart city context*
RQ.2. What is the significance of urban design to India's smart cities mission?	*Content analysis* *Field trip*	*Ch. 6: Smart Cities Mission of India: Urban Design considerations*
RQ.3. What are the barriers and opportunities that affect the implementation of smart cities in India?	*Case study and semi-structured interview analysis and discussion of results*	*Ch. 7: Case study of two cities – Quality of urban life* *Ch. 8: Case study of two cities – Barriers and Opportunities*
RQ.4. What should be the components of the urban design framework for Indian cities? .	*Proposed Conceptual Urban Design Guideline*	*Ch. 9: Urban Design Perspective in India's Smart Cities*

1.5 Contribution of the Research

The vast differences in the way urban spaces are conceived, planned and practised in developed economies like Australia and the contrasting approach in Indian cities has strongly motivated the researcher to investigate this gap when it comes to the design of urban spaces in India. This research contributes to developing an urban design approach in smart cities in India, that can find application in similar cities of the global South. The smart city model developed from the research will be useful to city planners, urban designers, administrators, industry bodies, organisations, and other stakeholders in the city building process. As stated previously, design of public spaces in India more often than not is implemented with the mere provision of basic amenities and services for the public space rather than a holistic and synergistic attempt to deliver one that offers visual and sensory pleasure to its users. The result is often an uncoordinated and lifeless space, owing to a design that fails to capitalise on its positive attributes. One of the solutions is to evolve a set of determinants that would influence the design of that space.

An extensive literature review is required to determine the gap between relevant studies on urban design in India. The findings of this research project will be of interest to both academics and practitioners of urban planning and design along with architects, geographers, social scientists, technology developers and government agencies, who are all related stakeholders in smart cities development. However, as highlighted in the literature, there is a lack of smart cities research relevant to cities in the global south and also place-based design approach supporting good urban design in smart cities. The term ‘global south’ is used by the World Bank descriptively to refer to countries with low to medium income, mostly located in Africa, Asia, South America and Oceania regions (M. Clarke, 2018). As more research becomes centred on these emerging economies, there is a gap in the research of the cities’ in these regions. This study will contribute to exploring the adaptation of the smart city model in city regions of the global south. Though the research is concerned with the impact of the smart city approach on the urban fabric of the city, technology, which is an integral layer in smart cities, is not the primary focus of this study. Establishing the need for an urban design perspective in a smart city is the principal goal of this research, which will contribute to the growing body of smart cities research.

1.6 Thesis Structure

The organisation of the thesis follows the sequence of the research questions. The thesis is divided into nine chapters, and the outline of the chapters is as follows. The first chapter illustrates an overview of the research, which includes background, and description of the research problem, investigated on the basis of the aim and the research questions.

Chapter two seeks to gain a deeper understanding of the smart city concept and explore what constitutes a smart city. The section starts by investigating the evolution of the smart city model as a city development strategy. It discusses the different aspects of the smart city idea and the various definitions of a smart city, and the six-dimensional model of smart city is then analysed. The chapter further discusses the increasing adaptation of smart city strategies and criticisms against the model. The final section identifies the need for a place-based approach in a tech-centric city.

Chapter three presents an overview of the impacts of urbanisation in India, as well as the principal planning challenges in Indian cities, as a result of rapid urbanisation and population growth. The chapter briefly examines the history of planning and design traditions in Indian cities and the current nature of the practice, providing a contextual background that paves the way for discussion about the Smart Cities Mission of India

Chapter four explains the research methodology of the thesis. The chapter introduces the multimethod strategy used and the rationale behind the choice. The section discusses the selected case studies, the validity of the selection and generalisability of the findings. A brief overview of the data-collection methods, including the case studies and the semi-structured interviews, is then presented. Finally, the research ethics and limitations of the methodology adopted are outlined.

Chapter five identifies how urban design would contribute to the six dimensions of the smart city model. The chapter develops a new theoretical framework for smart cities, with urban design as a contributing and unifying factor to these six dimensions of smart cities. The chapter also identifies the urban design action areas required in a smart city. suggested

Chapter six presents the SCM in detail with analysis of the proposals by the cities, to gain an understanding of the core areas the mission cities are proposing to address. The chapter also analyses the role of urban design in India's SCM, through analysis of the policy document of twenty cities.

Chapter seven brings out the first part of the case of the cities of Chennai and Coimbatore in the southern Indian state of Tamil Nadu. The study involved ethnographic observations and data from secondary sources is used to understand the study area

Chapter eight constitutes the second part of the case study. synthesis the findings to establish the urban design perspective for smart cities. The results of semi-structured interviews with key-informants are analysed and discussed in this chapter. The findings from chapters seven and eight helped in understanding of the barriers and opportunities to the SCM implementation.

Chapter nine is the final chapter of this thesis, in which the findings from chapters five to eight are synthesised to present a conceptual smart cities model for Indian cities, with an urban design core. The section finally highlights the significance and limitations of the research and potential areas for future research is suf.

CHAPTER 2

THE STRUCTURE OF SMART CITIES

2.1 Introduction

Chapters two and three of the research review the literature relevant to this thesis. Smart cities as a city model have gained traction only in the last decade, and with increasing adaptation of the city model, it is imperative to examine what constitutes a 'smart city'. As the term does not have a universally accepted definition; it is essential to understand its meaning, characteristics, advantages, and conflicts, to demonstrate its relevance in the context of city planning and design. This chapter aims to address preliminary question -1 of the study, both to review the smart cities concept and also to explore the importance of place-based design in a smart city. Accordingly, this literature review aims to understand the smart cities concept, including evolution of the term, definition, opportunities along with the many criticisms evoked by this concept, to gain a holistic understanding. The discussion outlines the various dimensions of smart city and the lack of 'place' focus within smart city approaches. The chapter consists of six sections; the first section discusses the various evolutionary theories on the origin of the smart city model. The second section elaborates the functioning principles of a smart city and a review of challenges in the smart city model of development in the third section. The fourth section investigates the lack of a universal definition of a smart city, thereby presenting the dimensions and indicators of the model. The fifth section discusses the relevance of place-based focus, and the final section concludes with a summary of the main theories and empirical findings from this chapter.

2.2 The Evolution of Smart Cities

The study of literature on the evolution of smart cities reveals that there have been contradictory claims on its origins. Probably due to the far-reaching multi-disciplinary premises of the smart city, it is difficult to pinpoint a single cause for the evolution of the smart city model. Varghese (2016) indicates that growth in mechanisation combined with droughts and famines ushered rural farm workers to seek job opportunities in towns and cities. This phenomenon paved the way for large scale rural to urban migration in many countries. While this sudden spurt in population led to overcrowding and unsanitary living conditions in 19^{th}-century cities, it was instrumental in making planners focus on improved city conditions. Buildings of the 20^{th} century progressively became the embodiment of inbuilt technologies such as electric wiring, lighting systems, air-conditioning and ventilation, elevators and escalators, telecommunications systems, security systems, fire and smoke alarms, cable/television, internet, closed-circuit television systems, and several others. The 1980s/1990s saw the popularity of intelligent buildings soar, which were managed by a central console connected to many wired sensors and actuators.

Even though technological innovation in building and city services is a result of natural advancement, it is difficult to identify the exact period of the emergence of smart cities in the ‘city planning’ discourse. While De Jong et al. (2015) claim that smart cities made an appearance only around 2009, Anthopoulos and Fitsilis (2013) state that smart city model has taken numerous forms over the past few decades. On the other hand, Glasmeier and Christopherson (2015) claim that today’s smart city ideas have their roots in the conversations of academics and practitioners of the 1980s who visualised future cities. In particular, Tatsuno (1992) in the early 1990s propagated the idea of transitioning of traditional cities into high-tech parks and formation of a global network of cities with interactive economic nodes that are interconnected by highways, airports and communication systems. Additionally, Tatsuno floated the idea of an “intelligent city” that works on the premises of advanced ICT (information communication technology), connected with satellite and fibre optics, an idea of Silicon Valley- like places everywhere. However, the critical difference between then and the current form of the “intelligent” (smart) city is the use of technology to transform places rather than using technology to drive the economy, as in the case of Silicon Valley.

Another of the earliest instances of urban development centred on technological innovation is the Multifunction Polis (MFP) proposal in Adelaide in 1994, which was eventually dropped a few years later (Droege, 1999). Though not referred to as a smart city, the city was conceptualised by fusing the three urban identities of Biosphere City (harmony with nature), Renaissance City (culture and learning), and Technopolis (research and development). Similarly, construction of the Multimedia Super Corridor

(MSV) in Malaysia in 1995 along with the establishment of two new intelligent cities, Putrajaya and Cyberjaya, inspired by the Silicon Valley model, identified technology as a core requirement (Ramaswamy, 2013). The initiative at that time was considered a leap into the future with proposals for smart card technology and application, ICT-enabled infrastructure, and smart schools, to name a few. Though named intelligent cities, this is a very early model of development that has a very close likeness to current day smart cities (Söderström et al., 2014), with technology at its core.

Kitchin (2015) demonstrates that though the competing ideas of wired and digital cities share the same kernel, meaning information technology (IT), they do not belong to the same genre as smart cities. Alternatively, Komninos (2002) and Hollands (2008) argue that the attribute ‘smart’ is a derivative from ‘intelligent’ that revolved around the interaction between urban spaces and technology that supports e-governance, innovation, social learning, and ICT infrastructure facilities. Singapore is the first country to embrace this vision and invested profoundly in a computing infrastructure that contributed to the ‘intelligent island’ branding (Arun and Teng Yap, 2000). Around the early 2000s, many world nations began integrating ICT into their city planning development strategies. Countries like the United States, Europe, and Japan have been investing in Research and Development initiatives to counter current urban issues like traffic congestion, high energy demands, inadequate infrastructure, health, and education. Cities in the European Union and the United Kingdom such as Amsterdam, Barcelona, Berlin, Bath, Edinburgh, and Manchester, have implemented smart city strategies. Cities in other regions like Dubai, San Francisco, Singapore, London, and Hong Kong are adopting similar methods to improve the way of life for the citizens and growth for businesses (Nam and Pardo, 2011). Anthopoulos and Vakali (2012) attempt to explain the different branding identities of various city forms in the academic literature that has ICT at its centre:

-*Web or Virtual Cities* – contain web environments offering local information and virtual simulation models of the cities. Examples - Kyoto and Amsterdam.

-*Knowledge-Based Cities* – include public databases that are updated using crowdsourcing enabled by software management mechanisms for appropriate open access. Examples – Copenhagen and Edinburgh

-*Broadband City/Broadband Metropolis* – comprising ultra-high-speed internet connecting businesses and households using "Metropolitan Area Networks (MAN)." Examples – Seoul, Beijing, and Antwerp

-*Mobile or Ambient Cities* – having easy access to wireless broadband facilities in the city for the free use of its citizens. Example – New York and San Francisco.

-*Digital Cities* – those mesh modern environments with interconnected digital and physical spaces by extending established resources. Examples – Hull (UK), Cape Town and Trikala (Greece)

-*Smart or Intelligent Cities* – adapting suitable approaches to encourage public participation and deliberation in addition to attracting private sector investments based on cost-effective ICT platforms. Examples – Brisbane, Malta, Dubai, and Kochi (India)

-*Ubiquitous Cities* – offering e-services to everyone across the city using pervasive computing technologies like cloud services supported by broadband cost minimisation. Examples- New Songdo (South Korea), Masdar (Abu Dhabi), and Osaka (Japan).

-*Eco-Cities-* that make use of ICT for sustainable development and environmental protection. The role of ICT is to help achieve high environmental ratings of buildings through reduced energy usage, deploying smart grids, and dependence on renewable energy forms. Examples – Dongtan and Tianjin (China) and Masdar (Abu Dhabi)

The different city forms are similar in many aspects, with little discernible differentiation between models. Despite the various typologies that share similar characteristics, there is no consensus on a definitive date on the emergence of the smart city as a city planning model. Shelton et al. (2015), attempted to position the smart cities contextually in time and place, argue their beginnings were much earlier. Smart cities literature with its basis on the scientific approach to systematic, quantitative, computational data collection, is considered to have its roots as early as 1913 when city planning was compared to pure engineering science (Ford, 1913 as cited in Shelton et al., 2015). Likewise, the modern approach to urban planning that revolves around banishing its problems with technology is compared to the similar historical inclination of planners to eradicate socio-economic problems with grand solutions (Howard, 1965; Hall, 2002). An investigation of the various journal articles over the last two decades reveals that there are four major lines of thought as the stimulus for its emergence.

Evolution due to the industrial revolution

The first industrial revolution was spurred by coal and steam power, driving the growth of steam engines, railways, and textiles. The second revolution resulted in mass production of the automobile, electrical, and mechanical industries, in which petroleum products played a key role. The third revolution in electronics and information industries and services promoted further automation (Renaud, 1979). The term fourth industrial revolution or Industry 4.0 (see Figure 2.1) was collectively coined by The Fraunhofer-Gesellschaft Institute and the German government to represent the various information exchanges, automation, and manufacturing technologies signifying this period (Chung and Kim, 2016). The ascension of smart cities seems to coincide with this phase of the industrial revolution as it also incorporates several drivers of this revolution like the Internet of Things (IoT) Internet of Services (IoS) and other technological advancements propelled by information technology (IT).

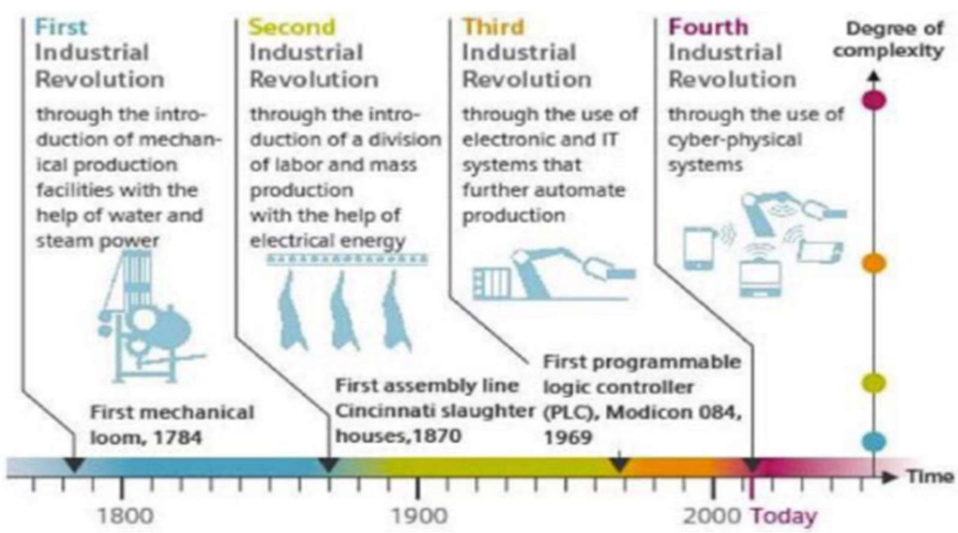

Figure 2. 1: Industry 1.0 to Industry 4.0

Source: Mathas (2013)

Need for climate-responsive cities

The second line of thought is proposed by Dhingra and Chattopadhyay (2016), who puts forth a new analysis that the emergence of smart cities coincided with the need for climate-responsive cities for a sustainable future. The authors identify five stages indicating the evolutionary timeline for this theory:

- Kyoto Protocol (1997) - influenced how cities are perceived, with emphasis on the environment
- Information technology boom (2000) - Easy flow of information facilitated by IT, led the way to terms like 'Digital City' and 'Wired City', based on this internet diffusion
- Enforcement of Kyoto Protocol (2005) - publications with the term smart cities began increasing
- Smart Technology (2007) - with the launch of Apple's iPhone, smart devices became everyday items

Evolution due to economic need

Zhou (2014) presents the third idea that draws parallels with the previous idea but with the perspective of economic development. Throughout history, there have been desperate measures to regain financial/market control after each economic crisis, as illustrated in Figure 2.2. There has been a new technology centred growth initiative after each of the recession. Therefore, the interesting question remains whether the surge in interest in smart cities among private technological organisations backed by governments is primarily a hidden motive to revive economic growth.

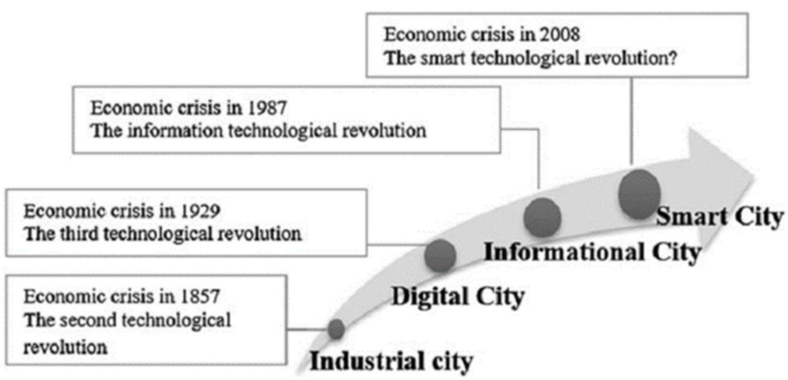

Figure 2. 2: Is Smart city an outcome of economic need?

Source: Zhou (2014)

Natural progression leading to an advanced city form

In an attempt to illustrate the evolution of smart cities, Anthopoulos and Fitsilis (2013) created a road map for over 20 years spanning the period 1989-2011 (see Figure 2.3).

They identify eight different smart city forms that were reliant on technology-centric urban development, which was tried and tested in this period, though not all versions are available today. However, the authors found that digital, ubiquitous, smart, web, and eco-city concepts as active at the time of publication, represented by several large-scale and ongoing projects. Knowledge-based cities were the earliest form that updated to digital cities, and broadband cities were the second approach that was followed by web cities. According to figure 2.3 below, smart cities came into existence around 1999 and regarded as a 'booming' phenomenon in the above research.

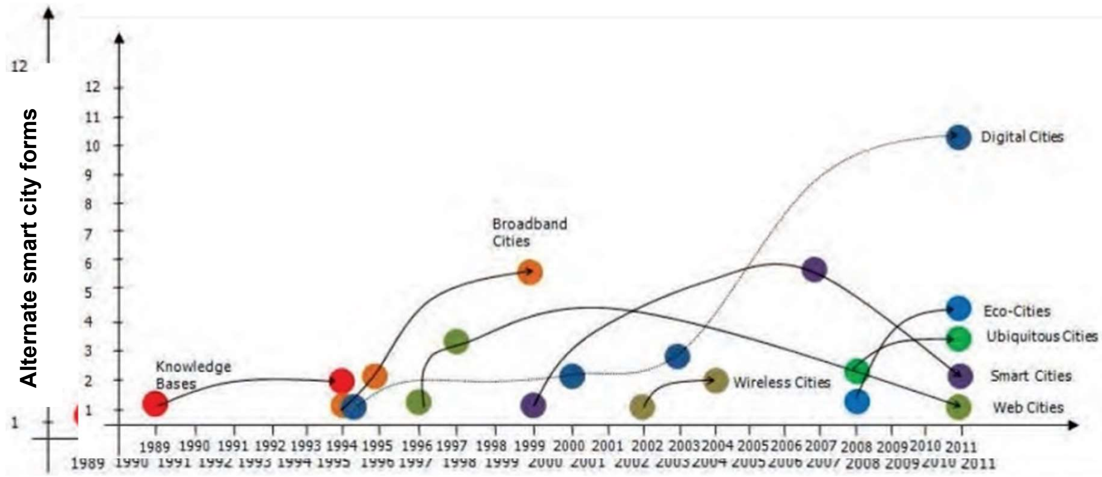

Figure 2. 3: Evolution of various smart city typologies over time

Source: Anthopoulos and Fitsilis (2013)

A systematic literature review by De Jong et al. (2015) concluded that the term 'smart city' is found in academic literature from around 2009. The authors view smart cities as a narrowly defined city category that has gained momentum only in recent years. The increasing competition among cash-strapped city governments to attract private businesses and a talented workforce by employing self-promotion tactics and highlighting investment opportunities is the reason for the growth in 'smart cities. However, they question how social equity and environmental conservation fits within this framework. While Anthopoulos and Fitsilis (2013) looked at city concepts that are similar to smart cities, De Jong et al. (2015) considered several concepts promoting sustainable urbanisation in the academic literature. The number of journals on smart cities is experiencing a phenomenal rise, though the concept itself or at least the terminology, is relatively new. Unsurprisingly as can be seen from the graph (see Figure 2.4), 'sustainable city' has been the most highly used term in literature since

1996, followed by 'liveable city' and 'green city. However, the term smart city made its debut only around 2009 and has risen exponentially since 2012, even surpassing 'sustainable city,' based on its frequency of use in academic journals. Though each of the concepts offers a different perspective on the role played by the citizens, government, urban infrastructure systems and services and the relation between the city and its surrounds, there is a lack of explicitly rigorous terms that clearly define the policy implications that in turn influence the urban development.

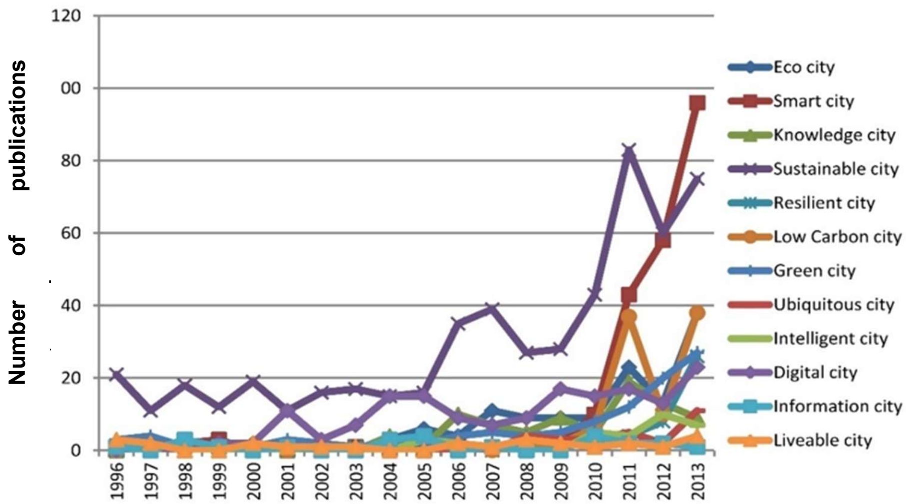

Figure 2. 4: Evolution of different city categories over time in journal publications
Source: De Jong et al. (2015)

While the first three theories are inconclusive, thematic interpretations without substantial evidence, the fourth theory is based on relatively factual data. Anthopoulos and Fitsilis (2013) investigative analysis state the appearance of smart cities typology in 1999 in the context of city services, whereas, De Jong et al. (2015) recognise the manifestation of smart cities in academic literature a decade after in 2009. Therefore, the exact beginnings of the smart city model are ambiguous and highly debatable. However, based on the various literature, it could be affirmed that various smart city services experimented within cities around the globe, either in isolation or as a cluster, began in the late 20th century. Similarly, the smart city as a definitive city form made its emerged only in the second decade of the 21st century and continues getting refined and adapted worldwide. Though the origins of smart cities are debatable, it needs consideration as an advanced city form.

2.3 The Dominance of Smart Cities

The advantages offered by smart cities towards city management are many, and this continues to rise with the advent of new technology incorporated into urban life. Given the data reliance of smart cities to make this contribution, the present-day smart city is viewed as an information marketplace by Mulligan et al. (2011) in their report 'Information Marketplaces: The New Economics of Cities". Apps and city dashboards are valuable tools that give the citizen fast access to information and also provide valuable data sets for local government agencies to mine and derive specific tools to support economic and social development (see Figure 2.5).

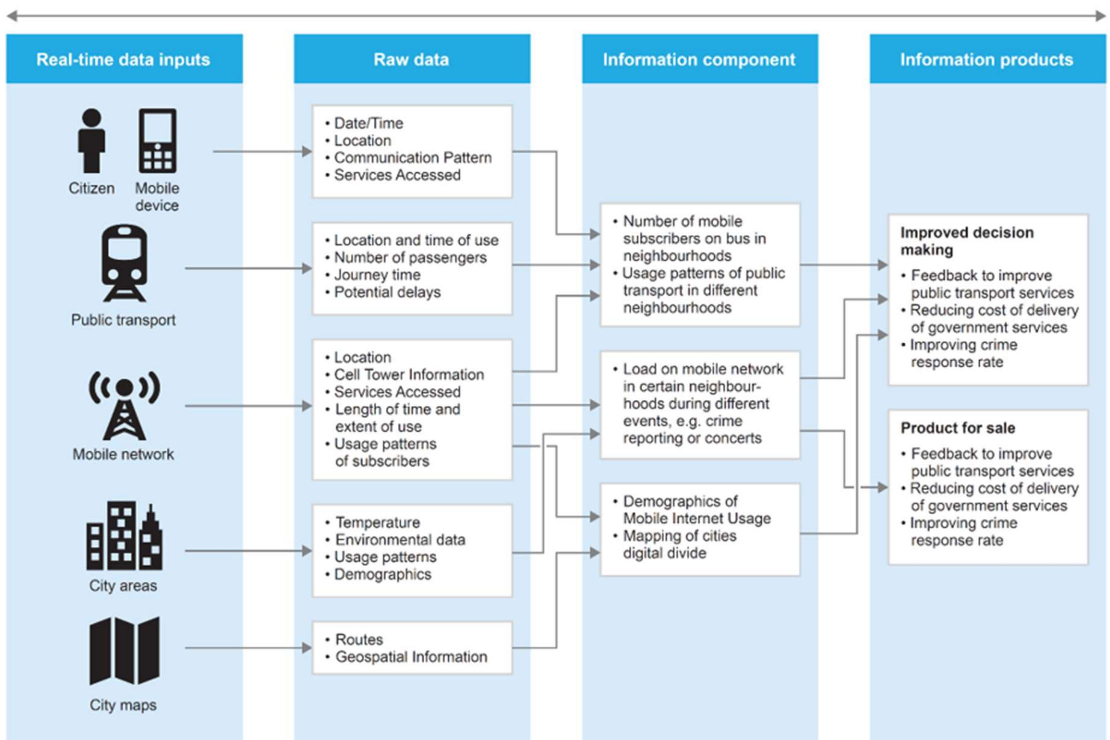

Figure 2. 5: Information Marketplace value chain based on real-time data of Rome

Source: Mulligan (2011)

Sacco et al. (2016) in their book chapter conducted a systematic literature review of articles to understand how geo-location-based urban sensing has been maturing in recent years, that has led to increased inputs towards the process of effective planning. Likewise, big data offers diverse opportunities for observing how cities function and provides an excellent platform for informed decision-making (Batty, 2013) in city planning. Big Data is defined as "the capacity to search, aggregate and cross-reference large data sets" (Boyd and Crawford, 2012,p. 663). Big Data, though viewed as new technology, is just an enhancement of existing technology of data processing stretched to process an ever-increasing spectrum of data. As highlighted by Al Nuaimi et al. (2015), data generated from multiple and expanding sources such as computers, laptops, smartphones, sensors, CCTV cameras, GPS systems in addition to data from social media sites, uploaded videos and pictures, advertising, gaming platforms and many more, shape the premises for the collection of data. However, the success of the technology for enhancement of cities depends on the analysis methods adopted and the useful classification of the analysed data. Depending on this, the benefits derived may include efficient resource utilisation, enhanced quality of life and higher levels of openness and transparency. Other than these uses, some of the other direct ways in which e-services help in urban planning are listed in Figure 2.6

e-Services	
e-Government	Public complaints, showing administrative procedure, bringing transparency in governance.
e-democracy	Performing dialogue, consultation, polling and voting of issues of city.
e-Business	Supports business installation.
e-health and Tele-care	Distant support and services to elderly, civilians with diseases, disabled
e-learning	Distant learning opportunities, training material to the students.
e-Security	Supports public safety via amber-alert notifications, school monitoring and natural hazard management
Environmental services	Information about recycling, guide households and enterprises in waste/energy/water management
Intelligent Transportation	Offers tools for traffic monitoring, measurement and optimization.
Communication services	Broadband connectivity, digital TV

Figure 2. 6: Relationship between urban planning and smart cities

Source: Town and Country Planning Organisation (2015) based on (Anthopoulos and Vakali, 2011)

Thrift (2014) argues that the extent of sentience in a city brought about by the existence of information technology systems does not necessarily mean the gleaming utopia conjured up by many writers. It is a valid debate on the limits of technology, yet it also provides several opportunities. A high level of computing technology can easily co-exist with extreme poverty, as is the case with mobile phone usage in African cities and biometric smart cards for slum dwellers in India (Sundaram, 2009). The potential improvements offered by smart cities can thus be quite significant. Nevertheless, most smart cities adopt a self-promotional approach (Ferronato and Ruecker, 2018), and an over-optimistic stance on its capabilities, spurred on by the digital capitalism of large corporations is the focus of the next section.

2.4 Debates on Smart Cities

A number of researchers have claimed possible contributions to improving city life in a smart city. Bajracharya (2014) support the potential of information technology tools in managing the environment and infrastructure in cities, public safety, monitoring transport networks, helping economic development and ensuring safer cities for the public. Hudson-Smith (2014,p.123) phrases the smart city as one of a 'smart citizen and smart design whereby the environment senses, streams, and adapts to the data'. Though smart cities relate to the place and space, it is the smart people (citizens) that are key to this concept. However, somewhere along with the various technical jargon, this central value tends to become lost and leads to several causes of concerns about this city model. Any dialogue on the smart city model also appears with warnings on its limitations and its side effects. The smart city, therefore, is one of the most highly criticised city models in recent planning history. Some other concerns, in addition to this non-human centric approach about smart cities, are listed below.

Corporate driven entrepreneurialism

One of the critical concerns raised by researchers is the smart cities role as a market-driven strategy to drive business profits rather than driven by an honest intent towards fixing the shortcomings in cities. Surging urban populations, together with the rapidly warming global climate and economic instability are reasons for new conceptions that place the urban technologies at the centre of solutions (Shelton et al., 2015). This corporate culture in cities is defined by Datta (2015) as an 'entrepreneurial urbanisation model' while Watson (2013) indicates that terms like 'eco' 'smart' 'global' 'knowledge' cities as 'promotional narratives'. Supporting this notion, Glasmeier and Christopherson (2015) consider the sudden hype about smart cities in recent years along the same lines as that of one of its primogenitors - 'intelligent cities,' that came into existence during the sluggish economic growth of the 1980s.

As Townsend (2014) puts it, the smart city propaganda is driven by the corporates as a remedy to issues that include traffic congestion, service inefficiency. Similarly, economic growth and crime reduction. In other words, smart cities get broadcasted as one medicine for all urban illnesses. Hollands (2008) identifies that this self-promotion tendency of smart cities as an excuse for adopting the corporate urban entrepreneurialism. He further questions about whether the cities were slowly becoming a backdrop for corporate advertisements and privatised public spaces that are business-led urban development models. Similarly, one other primary criticisms about smart cities are the disconnectedness between image and reality, i.e., whether the city is an intelligent one or if it is merely flaunting this as a fancy label (Hollands, 2008). Many of the world's leading software solutions providers are extending their focus areas to city-based applications for online service delivery systems that would cater to cities. They are also labelling their products to align with the 'smart cities' movement. IBM, one of the leading pioneers in this niche segment, expanded their routine services from utilities and traffic management towards intelligent strategic functions for city management (Batty et al., 2012). It is difficult not to draw parallels with the materialization of smart cities' discourse after the global financial crisis that dented profit margins of most prominent multinational companies across the world. It resonates with Zhou's (2014) theory discussed in the previous section. Therefore, the economic aspirations of the smart city promoters become convincingly established from these discussions.

Over sensing

The Dutch Architect and urban thinker Rem Koolhaas, one of the most influential architects of his generation, questions the changes happening to cities from being a domain of architects to that of 'city smart' – that focus on bringing the digital realm to the forefront. The criticism revolves around the propagation of smart cities by commercial protagonists presents apocalyptic scenarios like climate change, water, and energy crisis, infrastructure issues, an aging population that could be overcome by sensor-based smart solutions. With increased surveillance using sophisticated monitoring devices that record and senses each movement, the Architect predicts the day when each home may have a "Faraday's cage" as a safe retreat from digital sensing (Koolhaas, 2014). Therefore, raising the critical question on the limits to surveillance.

City dwellers are increasingly under the eye of the camera with a high level of closed-circuit television (CCTV) monitoring by various cities around the world. Although there are studies that suggest that passively monitored CCTV usage does not have a significant impact on reducing crime (Piza et al., 2019), city governments continue to invest in the video surveillance technology, with predictions to reach a market value of US$106.98 billion in 2026 (Business Wire, 2019). The privacy advocates and citizens oppose this idea of having to live under constant monitoring; the debate continues without a consensus between policymakers and the public. Additionally, the revelations by the whistle-blower Edward Snowden in 2013 on surveillance using data by the National Security Agency (NSA) and governments of other countries, opened the lid on large scale mass monitoring using information from the phone, the internet, and other websites. Under the umbrella term of "national security," personal information was gathered and analysed from unsuspecting ordinary users. By interconnecting data sets and applying analytical tools, the capacities of big data amply support intensified surveillance. Lyon (2014) warns that this increasing reliance on big data for monitoring in smart cities could lead us back to the times of authoritarian regimes.

Security Breaches

While increased connectivity has merged the personal and online worlds, it has also increased digital security risks as never before. For instance, in November 2014, it was found that a Russian website was streaming live video feeds from thousands of webcams belonging to schools, homes, and businesses from around the world. The cybercriminals and hacked into these internets connected systems by using default password settings. A more recent event is the hacking of power supply systems in the city of Johannesburg, South Africa (Pijoos, 2019). The level of hacking indicates that there are no traditional boundaries associated with the digital world as compared to the physical, and therefore international co-operation is essential to fight the menace of cybercrime as no city is safe. Inefficiencies in these cyber-physical systems have increased the vulnerability and risk in smart cities (Habibzadeh et al., 2019). Therefore, ensuring digital security is an equally essential criterion in the context of increasing digitalisation. Likewise, capturing data at various levels, including household data about citizens raises questions on data privacy, protection, and data security. The level of protection against cyber-attacks and hacking in smart cities has been a persistent question (Kitchin, 2016) that is not answered conclusively so far.

High infrastructure costs

The set-up costs for smart cities is a crucial factor to be considered, especially in the case of existing cities. The interoperability between existing services and new infrastructure could potentially lead to unexpected inefficiencies, therefore, resulting in higher costs. It is also possible the smart solutions when implemented through economies of scale, can reduce costs considerably. However, it is also possible the smart solutions, when achieved through economies of scale, can reduce costs substantially. The main issue for cities, therefore, will not be the initial set up fees but the annual maintenance costs. Any information technology device or software is bound to become outdated every few years, and hence frequent upgrading, fixing issues, and periodical maintenance that can be done only by qualified personnel are likely to increase the annual costs of the system (Centre for European Policy Studies, 2014). Flawed technology (Benner and Conger, 2019) also contributes to the high costs and security flaws, due to the monopoly of a few large companies taking advantage of the market situation.

Lack of regional and global perspective

Smart city concept lacks an overall global perspective that could interlink the world urban network, and the present approach around the world focuses only on a local-urban scale (Tranos and Gertner, 2012), ignoring the global-urban dependencies. In simple words, given the post-industrial world, which is anything but flat (Friedman, 2005), how can cities be rated smart if they do not consider these interdependencies. Derudder (2006) confirms that cities reach the top of the global hierarchy not simply due to what they contain within them but also because of what flows through them. These flows would include trade, tourists, air passengers, students, knowledge and advanced producer services, to name a few. Given that cities cannot and do not exist in isolation (Storper, 1997), this rather important aspect of the global dimension is unfortunately often ignored in the smart cities framework. Global knowledge clusters like the 'European innovation partnership on smart cities and communities' are working towards bringing the much-needed global perspective. However, a high-level regional approach inside each country, followed by a global perspective is required.

Though the issues discussed above are of considerable importance, most other city models have negative impacts as well. Although the smog of digital data that is being generated by a city is growing multi-fold every day and presents increased challenges in safely storing, assessing and extracting useful information, if tagged with the location, the data could be useful to retrieve a real-time view of the city. Likewise, most of the disputes regarding smart cities discussed in this section are based on technological premises. However, it is essential to consider assessing smart cities beyond the uni-dimensional, technology/ICT related challenges; otherwise, it becomes a limited assessment of what a smart city represents. The next section, therefore, looks more deeply into the different aspects that make a city ‘smart’, to gain a broader understanding of this city form.

2.5 The Definition of Smart Cities

Historically, communities raced to create ports, railway stations, airports and highways to bring in businesses and increasing job opportunities. In the twenty-first century, broadband and information technology are viewed next only to clean water, sewer systems and dependable electricity (Middleton, 2015), as the main priorities for achieving prosperity (Pradhan et al., 2018). Two decades ago, Batty (1997) predicted that by the year 2050, everything around us will contain some form of computerisation and will lead to a ‘Computable City.’ Batty’s visionary ideas have almost come to be fulfilled in the current age as places and spaces are becoming increasingly interconnected through mobile communications. This demand for ‘anytime, anywhere access and control’ (Cosgrave et al.,2013) has exemplified the need for smart cities. Parallel to the rise in big data and cloud computing, advancements in hand-held mobile technology, ably facilitated by applications or commonly referred to as ‘Apps,’ have also supported the growth of smart urban technology. It is first vital to understand the technological aspects of the city form to understand the components or the composition of smart cities. Anthopoulos and Tsoukalas (2006) present how the various interfaces interact and interlink in their overview of the different layers. Smart cities are a part of the broader digital city concept, wherein the multi-tier architecture of digital cities has the following layers (see Figure 2.7)

1. User layer –relates to all end users and local stakeholders of the city, comprising all including consumers of the services and decision-makers
2. Service layer –comprises of all e-services offered by the city
3. Infrastructure layer -concerns the networks and information systems that contribute to the distribution of e-services
4. Data layer – includes all information generated and collected in the city

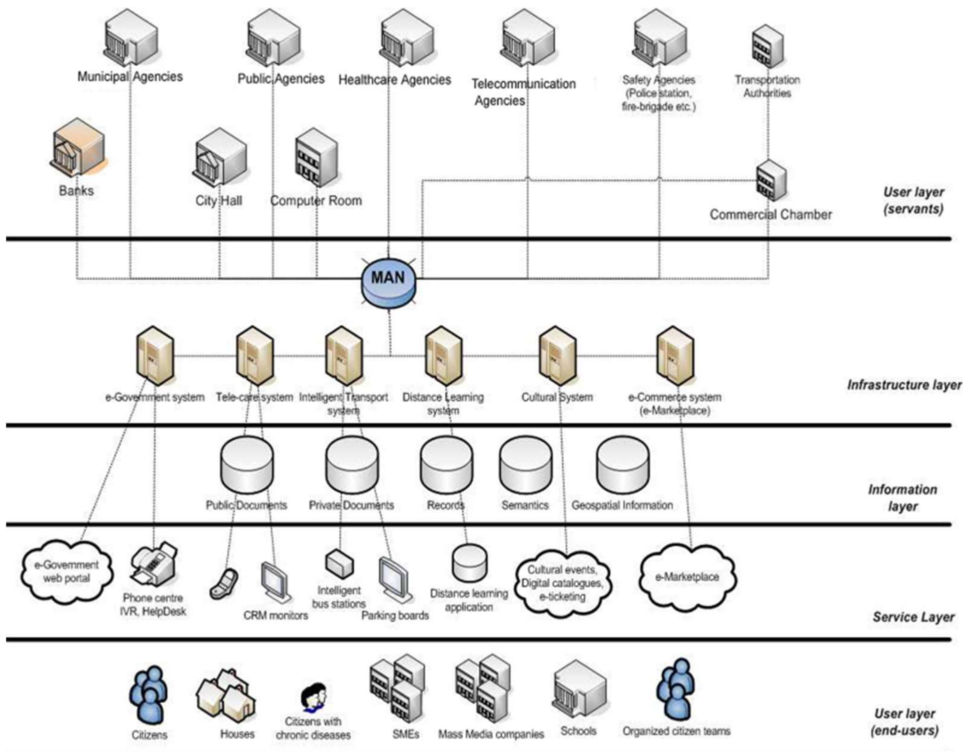

Figure 2. 7: The multi-tier architecture of a digital city

Source: Anthopoulos et al. (2006)

While the digital framework for the smart city is conclusive from the above-interlinked interfaces, it does not cover the interpretation of the smart city concept that needs settling. Based on a casual consideration of the term, it appears to be an extension of the various technological advanced products like the smartphones, smart speakers, smartwatches, smart televisions and smart homes, that continue to dominate the physical world in the last two decades. Other than the immediate resonance to technology, due to the use of 'smart' in the terminology, the term smart cities evoke only a vague sense of understanding. Therefore, to define a smart city is pertinent to the understanding of this city model, an intriguing challenge. Smart cities are regarded as a fuzzy concept by numerous authors (Caragliu et al., 2009; O'Grady and O'Hare, 2012; Cocchia, 2014; Lara et al., 2016a), and this is where the agreement stops. The city model is considered ambiguous because of the lack of a universal definition of smart cities, coupled with a growing number of definitions each year. As an integrative city form, it encompasses many disciplines such as city planning, built-environment, sustainability, geography, big data, urban technology, environment, social sciences, urban design, public policy, systems engineering, ICT, urban mobility, telecommunications and so forth. The heterogeneous nature of the smart city has resulted in the development of the increasing number of definitions by researchers, private institutions, government bodies and several other professionals.

This lack of a universal definition may be attributed to a number of theories. One such theory by Söderström et al. (2014) relates to both smart cities terminology and the concept as one of the several language games surrounding urban development and its management by technology companies. IT companies produced much of the early literature on smart cities as a way of self-advertising, which lacked critical engagement. Söderström et al. (2014) argue that especially after 2011, there was a surge in critically scrutinised views from different frames of reference in terms of science and technology, national studies, political economy, and ideological studies that focused on more than the self-celebratory literature published by the IT companies. IBM, the forerunner in these promotions had a clear intent of legitimising the visibility of IT companies within the smart city domain. In this context, the official trademark registration of the term ‘smarter cities’ by IBM is viewed as the ‘obligatory passage point’ in the implementation of urban technologies in cities..

The sceptical outlook on IBM’s self-promoting efforts needs to be justified by scrutiny of the company’s performance in the last few decades. The period between 1990-2000 resulted in heavy losses to the company that ultimately resulted in IBM withdrawing its hardware core business and focusing only on software development and consultancy services. Having realised the market potential for urban technologies, IBM launched its ‘smarter planet’ campaign in 2008. Internal studies conducted by the company revealed the potential of urban technology as an untapped market, giving IBM a key advantage owing to its global presence. IBM’s strategy paid off remarkably generating revenue of three billion USD, representing 25 per cent of IBM’s operations, as observed by Hollands (2015). The smart city campaign, exceedingly driven by technological companies, was more of a business interest in gaining a new territory than a pure notion of urban development for an improved way of life for the masses.

Simultaneously, organisations like Bloomberg Philanthropies and Knight Foundation have been promoting data-centric initiatives that range from funding municipal government restructuring to awarding grants to technology start-ups. Likewise, organisations like the European Innovation Partnership on Smart Cities and Communities have been instrumental in facilitating smart technology to address energy and transportation issues in European cities (Shelton et al., 2015). Possibly due to the reason that the initial proponents of smart cities were, to a large extent industrial organisation, there has been no universally accepted definition of smart cities to date. It is therefore regarded as a fuzzy or nebulous concept and has been defined in numerous ways by different stakeholders. Some of the widely used definitions listed in Table 2.1 are quite diverse in the domain areas they address.

Table 2. 1: Key definitions of smart cities

Definition of a Smart City	Source	Key indicators
Academics and Researchers		
"A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimise its resources, plan its preventive maintenance activities, and monitor security aspects while maximising services to its citizens."	Hall et al. (2000)	Infrastructure Governance Security Citizens
"A city well performing in a forward-looking way in economy, people, governance, mobility, environment and living, built on the smart combination of endowments and activities of self-decisive independent and aware citizens. "	Giffinger et al. (2007)	Economy Mobility Governance Environment Living Citizens
"Smart City is referred as the safe, secure environmentally green, and efficient urban centre of the future with advanced infrastructures such as sensors, electronics, and networks to stimulate sustainable economic growth and high quality of life."	Schaffers et al. (2012)	Infrastructure Sustainability Economic growth Quality of life
"Places where information technology is combined with infrastructure, architecture, everyday objects and even our own bodies to address social, economic and environmental problems "	Townsend (2014)	Smart infrastructure Sustainability
"A community that systematically promotes the overall wellbeing for all of its members, and flexible	Lara et al. (2016a)	Quality of life Community Liveability Sustainability

enough to proactively and sustainably become an increasingly better place to live, work and play.”		
Industry		
“Every step towards becoming a smarter city creates efficiency, and every bit of efficiency alleviates some of the strain on city budgets freeing up time and resources to focus on driving economic development and prosperity. Developments in technology have fundamentally increased the value that cities can generate for their citizens, their city, and the planet. Let us build and Smarter Planet ™, city by city.”	IBM (2012,p. 3)	Efficiency Economic and technological development Smarter Planet
Smart cities are those that adopt “scalable solutions that take advantage of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life.”	Cisco - Falconer and Mitchell (2012)	Information and communication technology, Efficiency, Lower costs, Quality of life
Institutions		
“Smart Cities” is a term denoting the effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens	British Standards Institute (2014)	Systems integration, The built environment, Sustainability, Inclusivity
A smart city is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business. A smart city goes beyond the use of information and communication technologies (ICT) for better resource use and fewer emissions. It means smarter urban transport networks, upgraded water supply, and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces, and meeting the needs of an aging population.	European Commission (2019)	Technology, Citizens, Businesses, Resource management, Emission reduction, Smart infrastructure, Safety, Governance, Inclusivity

As seen from the above table, the definitions try to capture the different aspects of the smart cities, without necessarily being all-inclusive. The following figure (Figure 2.8) captures the most frequent words used in the above definitions generated using the free online tool called wordcloud.com. The figure illustrates the key words prominent key areas as sustainability, efficiency, infrastructure, economy, citizens, resources and ICT, to name a few.

Figure 2. 8: Word cloud from various smart cities' definitions listed in Table 2.1

Source: Author's elaboration

Given the varying nature of the definitions, it is interesting to reflect on the arguments regarding the lack of a universal definition. It is possibly due to its propagation of the model by the technological companies (Söderström et al. 2014) that pushed the momentum with smart cities, that could have resulted in the lack of unified definition.

<u>Working definition of a smart city</u>

A smart city can be defined as a city which makes optimal use of information, innovation and technology to effectively deliver and manage an integrated and holistically designed physical, digital, human and natural environment that is sustainable, inclusive, collaborative, transparent and strive to deliver a good quality of life for all

One of the earliest full-fledged definitions proposed by non-technology companies is by Hall et al., (2000), a group of nuclear physicists who published a paper funded by the US Department of Energy. The definition by the British Standards Institute (listed in table 2.1), captures the essence of smart cities more succinctly and fits within the broader parameters which the smart city tries to address. For this thesis, a working definition of smart cities framed, as stated below. The definition attempts to combine innovation and technological advancements to holistically aid in city planning, designing, building and management of the city services for operational efficiencies. Given the broader and diverse qualities addressed by a smart city in different cities of the globe, the smart city model needs recognition as a 'versatile' and 'adaptable' city model. The next section will demonstrate some of these diverse aspects of smart cities.

2.6 Conceptualizing Smart Cities

Given the lack of universal definition mandates the need to demonstrate smart city characteristics through other methods. Several smart city researchers have agreed on the six distinct action areas that distinguish smart cities. Caragliu et al., (2009), Schuurman et al., (2012), Batty (2012) and Vanolo (2014) have all acknowledged the six characteristics of Governance, Economy, Mobility, Environment, People and Living, as crucial components of a smart city. One of the earliest research documents to identify the six dimensions of the smart cities was the report collectively prepared by Vienna University, Delft University and the University of Ljubljana by Giffinger et al., (2007). The leading indicators devised by the authors that characterise these six areas is shown in figure 2.9.

Giffinger et al., (2007), through a series of workshops, identify thirty-one factors under the six characteristics and lists seventy-four indicators that make up the factors. Boyd Cohen (2012), an urban and climate strategist uses formulated the smart city wheel a diagram (see Figure 2.10), identifying the six action areas and eighteen indicators for benchmarking the smart cities. Further to this, Cohen (2014) further refined the wheel and expanded to sixty-two indicators, retaining the six action areas or dimensions. He acknowledges the difficulty in identifying the exact indicators required in accurately benchmarking smart cities and developed the list in collaboration with the global advisory committee he set up. Annexure- A reproduces the indicators included in Giffinger et al.'s model and Annexure- B elaborates the indicators compiled by Boyd Cohen. It is interesting to note that neither Giffinger et al., (2007) or Cohen's (2014) list include any indicator for the physical quality of the built environment, though the lists included smart buildings.

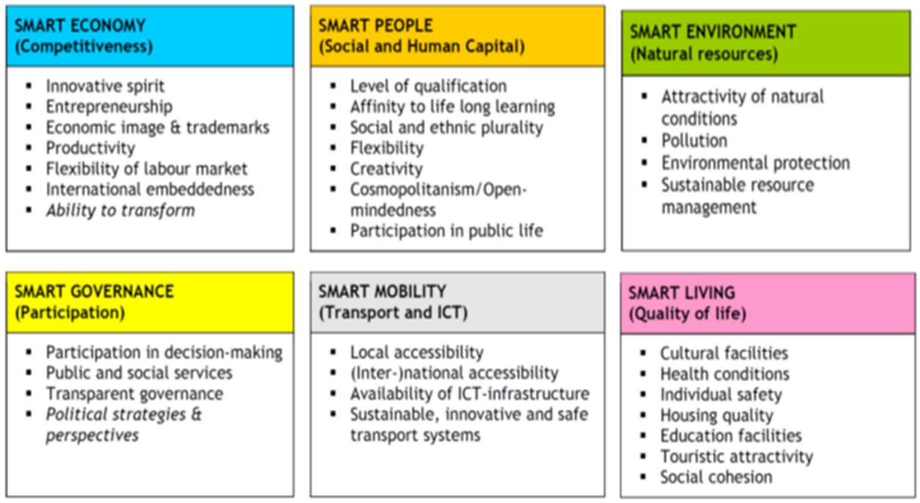

Figure 2. 9: Smart city characteristics

Source: Giffinger et al. (2007)

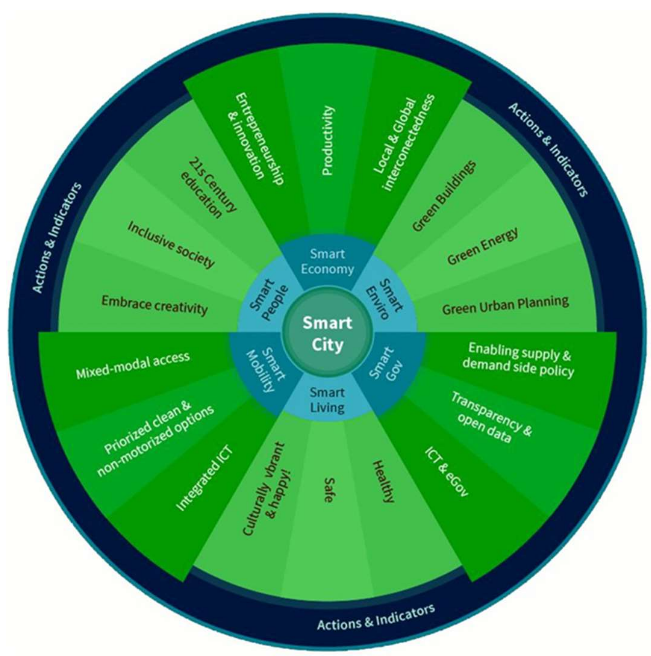

Figure 2. 10: Smart City Wheel

Source: Boyd Cohen (2012)

The Smart City wheel by Cohen has been increasingly acknowledged by several researchers including and not limited to, Vidiasova et al. (2017), Ahvenniemi et al.

(2017), Loo and Tang (2019), Marchetti et al. (2019) and Zhang et al. (2019). Bhattacharya et al. (2015) identify the wheel as one of the four indexing methodologies of smart cities. The authors identify that the wheel by Cohen could find application in any city around the world. Likewise, the six action areas and the succinct representation of the model in Cohen's wheel has found resonance among many cities. The figures 2.11, 2.12, 2.13 and 2.14 presents that the smart city strategy adopted by different cities. Brussels, Dubai and Newcastle's frameworks closely align with the Cohen wheel with six main dimensions. However, Vienna, Austria (see Figure 2.12) adopts a three-dimensional approach though several of the indicators share similarities with the Cohen wheel. Similarly, even in the case of Brussels, though the six components match with the Cohen wheel in principle, some of the indicators slightly vary. Dubai, on the contrary, has around thirty indicators (see Figure 2.13) compared to the eighteen in the Cohen wheel.

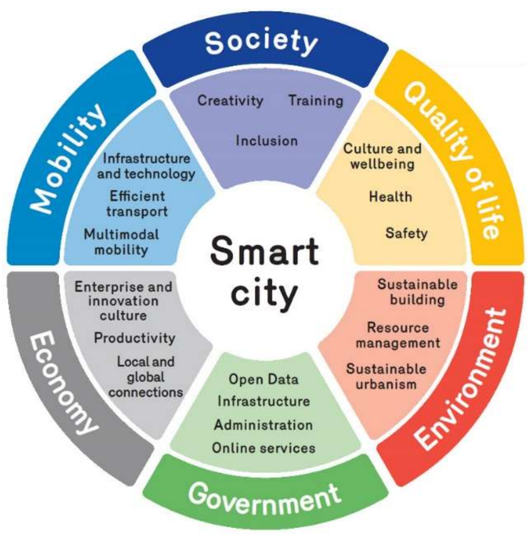

Figure 2. 11: Six Action Areas of Smart Cities

Source: Brussels Smart City (2019)

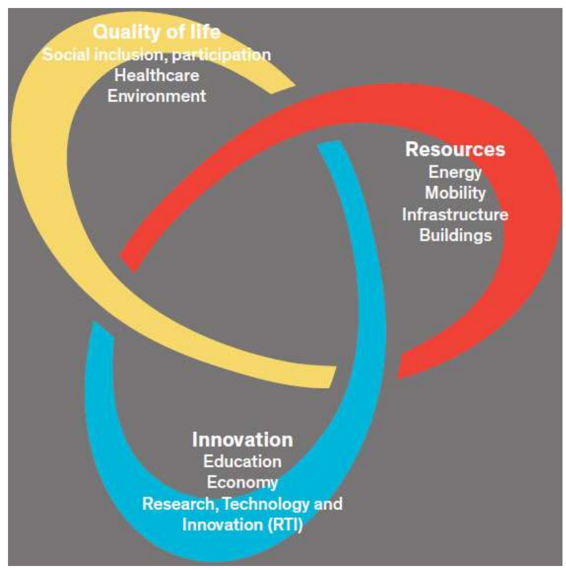

Figure 2. 12: Smart city framework for Vienna

Source: City of Vienna (2014)

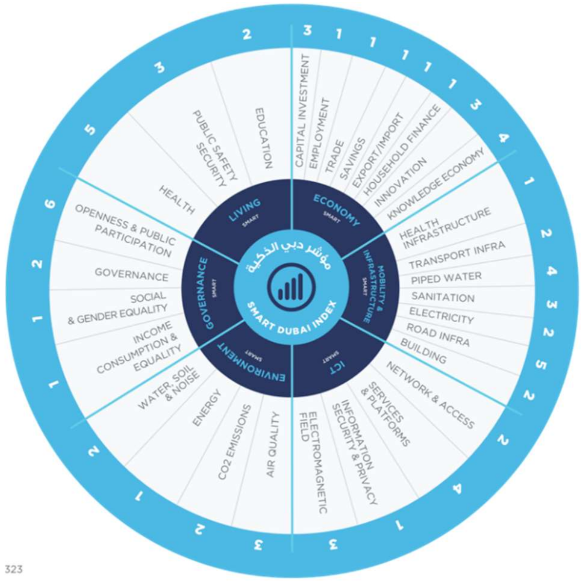

Figure 2. 93: Smart Dubai Index

Source: Salem (2017)

Figure 2. 14: Smart city strategy Newcastle

Source: Newcastle City Council (2017)

The smart city models adopted by the four cities of Brussels, New Castle, Dubai and Vienna, when compared with the Cohen Wheel, reveals the following details (see Table:2.2). The parameters adopted by New Castle smart city is almost identical to the Cohen wheel, while Brussels used the term 'Society' and 'Quality of Life' in place of 'People' and 'Living' respectively. Interestingly, Dubai's dimensions do not include the 'People' aspect, but ICT is regarded as the sixth dimension. However, Dubai, as part of its smart city strategy, launched the national agenda for Happiness and Well-being (UAE, 2016).

Table 2. 2: Comparison of smart city dimensions

Cohen Wheel	Brussels Smart city	Newcastle Smart City	Dubai Smart City	Vienna Smart City
Smart People	Society	Smart People	ICT	Innovation
Smart Economy	Economy	Smart Economy	Economy	
Smart Governance	Government	Smart Governance	Governance	Resources
Smart Mobility	Mobility	Smart Mobility	Mobility and Infrastructure	
Smart Living	Quality of Life	Smart Living	Living	Quality of Life
Smart Environment	Environment	Smart Environment	Environment	

As collectively evident from the above cases, though the adoption of the six-dimensional approach is almost universal, it can be seen that the components or indicators that determine the 'smartness' of the city is flexible and is custom-fit to suit a country or city context. The evidence strongly supports the theory put forth in the previous section on the versatility and adaptability of the smart city model. Together, in both Cohen's wheel and Giffinger et al., (2007)'s model, the action areas or dimensions represent various facets of urban living, and the indicators identify the parameters to achieve a quality urban life. However, the focus on 'place' and the need for delivering good placemaking is absent. The 'place' component is represented only as a hidden element in Giffinger et al., (2007)'s model (see Appendix-A), while Cohen (2014) works through indicators such as green buildings, green urban planning, healthy living conditions, sustainable transport systems and establishing high-quality housing, education and cultural facilities (see Appendix-B). The indicators addressing good placemaking and well-designed urban spaces are missing. Even though several of the above indicators can be identified in creating good 'place' outcome, the lack of specific attributes to address the place dimension is quite evident. The next section, therefore, brings out this missing perspective more in detail and discusses the need for place-based approach in a smart city.

2.7 Place-based design in a smart city

The UN-Habitat Sustainable development agenda for 2030, sets 17 sustainable development goals and 169 targets for world cities. Among these 17 goals, the stand-alone goals are specific to make cities 'inclusive, safe, resilient and sustainable' (United Nations, 2015). Likewise in the same year and on the occasion of the World Cities Day, observed annually on the 31st October, the then UN Secretary-General Ban Ki-Moon stated that good city design can aid in reducing impact of disasters, tackle climate change and thereby resulting in safer, cleaner, inclusive, and integrative cities that would nurture contentment for its inhabitants (UN News, 2015). Also, to deliver sustainable urban development in the next decade, the balance of the three components of urban legislation, urban planning and design and urban finance is identified as the foundation (see Figure 2.15). Design of urban street space with appropriate connections, clear layout of blocks with mixed-use provisions and walkable areas, well-designed public and open areas are all seen as essential to contribute to the value of urban life (UN Habitat, 2015). Good urban planning practices is, therefore, central to developing and building sustainable communities and cities.

Figure 2. 15: Vision for Sustainable Urban Development

Source: UN Habitat (2015)

While 'Smart' and 'Sustainable' cities may appear to imply two varied concepts, they are also both heterogeneous with several fragmented elements constituting their characteristics. However, as Rivera et al. (2015) indicate, a sustainable city is reliant on smart city solutions such use of ICT to deliver some of the outcomes required like pollution monitoring and reduction, assessing energy performance levels, resource management, evaluating social and environmental impacts and computing consumption, to name a few. One of the principal goals of smart cities is to improve sustainability (Ahvenniemi et al., 2017). A sustainability focus provides the smart city model with a strategic direction to achieve meaningful urban development and growth. As Bibri and Krogstie (2017) point out, there are still several gaps in the policy and technical processes of both smart and sustainable cities. Again, not all emerging smart solutions focus on achieving sustainable goals. Nonetheless, there is no doubt that continued research, discussion and future practices should focus on delivering sustainable cities and communities within the broader smart cities' framework. Therefore, to deliver a smart city that is also sustainable, it becomes imperative to focus on one of its crucial aspects; namely, urban planning and design (see Figure 2.16).

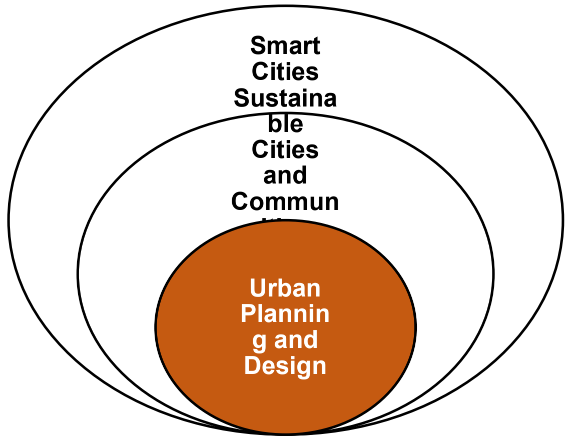

Figure 2.16: Relationship between urban planning and design with smart cities

Source: Author's elaboration

Despite the various advantages and disadvantages of the smart cities model, compelling evidence suggests that smart cities have unmistakably evolved as a widely adopted city model. Nevertheless, place-based focus on planning and design is not positioned clearly within the smart city domain and present only as a concealed component. Referring to Kourtit et al.'s (2012) description on smart cities again, the high technological reliance leads the cities in becoming more as '*place of senses'* instead of evoking the '*sense of place'*, achieved through good urban planning and design practices. A city is largely a product of its public spaces, which are not merely the spaces between buildings in a cityscape (Gehl and Koch, 2006) but comes in different forms and semblances, ranging from informal street corners to more extensive civic settings (Carmona, 2019). Therefore, this necessitates a strong focus on planning and urban design within a smart city context.

Proper planning provides the premises for good urban design. In a smart city, this premise gets enhanced by the increased use of technological inputs. A high quality urban designed space is a prerequisite in an efficient planning system combined with an excellent spatial plan. Local government authorities must compile a core strategy and vision document for the future decade to achieve quality urban design (CABE, 2009). However, despite the ever-growing interest in the smart city as a possible means to achieve sustainable cities, administrators are struggling to convert higher-level concepts of smart city literature into effective city-level policy outcomes and programs that deliver quantifiable value to their residents (Cosgrave et al., 2013). The reasons for this gap in implementation found by the authors, which is still relevant, include:

- Smart city concepts are still evolving due to high dependence on technology and delay in underlining the conceptual grounding
- The complexity of the city itself presents a massive challenge with 'an enormously complex and open-ended system, with many intertwining force fields influencing its form simultaneously' (Sevtsuk and Beinart, 2005)
- Innumerable unknown elements when dealing with the future.
- Limitations in investment capabilities due to funding mechanisms; and
- Uncertainty over long-term implications of the technology

It is indispensable to understand how a place needs planning and designing in a smart city. Cuthbert (2007) claims that urban design as a field has failed to evolve its theoretical underpinnings but has been acting as an ancillary to other disciplines. Nase, Berry, and Adair (2015) consider that there are three trends when it comes to the theory of urban design, due to the middle position it occupies as far as a discipline goes. Firstly, the laying of a claim by different disciplines and thereby outlining its territories and defining the field within set boundaries. Secondly, the dilemma is to establish whether to fit the discipline either as a process or a product. Academics view this as a process, whereas practitioners view it as a product. There is also another dimension to the debate put forth by Madanipour (1997) that urban design is both a process and a product. However, the third debate positions the field of urban design as merely a filler discipline that infills the gaps created by other disciplines like architecture and planning (Madanipour, 1997, 2006).

Considering the above viewpoints, it can be argued that the 'place' context of smart cities is amply covered by the urban planning indicator, which is placed within the Environmental dimension in Cohen's smart cities wheel model. The positioning of urban design, like smart cities, is often found debatable. There does lie a few counter views that contest urban design's position as a separate discipline, but one that still firmly lies within the domain of urban planning. Gunder (2011) views urban design as a by-product of neo-liberalization, which lacks the critical reflection of a standalone field due to its ‘myopic view’ limited to physical design. He recommends that by introducing urban design studies to planners, planning education could strengthen the urban design angle, thereby fusing it with planning. While such a negative perspective is less, there are several strong arguments to contend with this view. Lang (1993) confronts that urban design enriches human experiences in cities. Cuthbert (2018) admits that after several years of contesting urban design’s significance, he agrees with the renowned scholar Jon Lang that ‘urban design is not a sub-set of architecture and planning’ but an independent discipline without being an extension of either architecture or urban planning. Even as early as two decades ago, Lloyd-Jones (1998) acknowledged urban design as a distinct area due to changing societal changes. The field addresses relevant contemporary needs like the quality of life and environmental issues.

Urban design is often identified as falling within the public, or collective good category on two fronts. One is the profession itself meant to contribute to the community by the service of designers/architects and second that the product or the creation of public spaces like plazas, squares, well-designed streets and parks meant for the benefit of many. However, several researchers have identified a decline in the quality of the urban realm, especially in emerging economies. Chitrakar et al. (2017) highlight that the lack of or poor management of urban spaces reduces the quality of these spaces both physically and visually. Mandeli (2019) identifies that when it comes to public space design quality, most research has its basis on the western perspective. Therefore, the need arises for looking into new approaches towards public area provision in emerging economies through innovative policy-making and proactive approach to urban design.

Smart city concept has gained immense popularity under the premises of creating economic opportunities and enhancing global competitiveness beginning with employing small-scale technology-based applications right up to metamorphosing entire urban regions using ICT and its related developments (Lee et al. 2014). However, as Caragliu et al. (2011) point out, this unidimensional identification of likening smart cities to ICT infrastructural developments cannot be validated. Walters (2011) states that ‘place’ does matter, even in smart cities and towns, even though ‘smart’ in cities could be often interpreted in different terms as varied as sustainability right up to the use of virtual technologies. Although technology seems to push us apart, the author claims that the smartest of places is the one where the physical and virtual worlds are fused seamlessly. It is still debatable whether computational technologies will be successful in creating smart cities or end up fracturing the quality of urban life. It is also undeniable that ICT will continue to evolve and challenge our perception of our cities and neighbourhoods, thereby generating unexpected new dimensions to the way we live, work, and play. Though the negative aspects of this evolution could be equal or more to the positive outcomes, the chance does lie with offsetting the concerns and counterbalancing them with place-based planning and urban design. Walters (2011) conveys that the techno-futurism will likely lead us to crave a more place-based experience that only a well-designed physical space could provide. This gives the premises for positioning urban design and planning as a critical component of smart cities to result in a coherent, inclusive, and integrated cityscape. Therefore, the need arises for an urban design framework that establishes the linkages between urban design and smart cities.

2.8 Conclusion

This chapter reviews the literature on smart cities in the context of identifying the theoretical framework for smart cities. It considers the various, often conflicting definitions of smart cities, highlighting the lack of a universal definition. The absence of a standard definition is identified owing to the diverse set of attributes that contribute to the city making process, in a smart city. However, the versatility of smart city model provides the premises for city governments or individual nations to tailor-make their smart city proposals to fit the local context. Nonetheless, 'place' based action areas are identified as missing in the various smart city development models. Empirical studies reveal that most cities, especially in emerging economies, are facing deterioration in the quality of the public realm, resulting in the decline of quality of life. Therefore, in this context, urban design is considered to be a stimulus in reinvigorating the public realm in cities that hope to become smart in future.

CHAPTER 3

OVERVIEW OF PLANNING AND DESIGN IN INDIAN CITIES

3.1 Introduction

India has witnessed an enormous, population shift from rural to urban settlements. Combined with population growth, this has caused a considerable increase in urban areas in a short timeframe. Even though policy and planning approaches were employed to regulate and achieve structured growth of cities, to accommodate this increase in population, these attempts have failed, due to a number of issues, thereby leading to infrastructurally deficit cities. This chapter attempts to answer preliminary question-2 and investigates the current state of urban planning and design in Indian cities. The chapter reviews the critical issues concerning urban growth in Indian cities and the urban planning and design traditions in Indian cities. The purpose of this chapter is also to discuss the critical planning challenges that face current Indian cities within the contextual background as future smart cities.

The chapter explores the literature in four main sections. The first section outlines the broader aspects of urban India, including the predominant challenges in its cities. The historical planning and design background, in the context of pre and post-British occupancy of India, is discussed next. The current planning practices and a detailed examination of the planning roadblocks in modern India are then considered in the next section. The stance taken by Indian cities on the urban design front is then considered. The fourth section introduces the SCM of India and how it fits within this broader context.

3.2 Urban India

The World Urbanisation Prospects document published by the UN states that a clear majority of the megacities and large cities are in the global South. Close to 90 % of the rural population lives in Asia and Africa, with India being home to the most significant rural community in the world with 857 million habitants. Likewise, Asia has 53 % of its population living in urban areas, despite low urbanisation rates compared to other continents. The Indian cities of Ahmedabad, Bengaluru, Chennai, and Hyderabad, with a current population varying between 5-10 million, are expected to become megacities by 2030, increasing India's tally of megacities to seven, in addition to the three cities of New Delhi, Mumbai (formerly Bombay) and Kolkata (formerly Calcutta) (United Nations, 2014). Developing countries like India and China, representing the global south, face the unique challenge of addressing the growing development needs of rural towns and villages and at the same time planning for the ever-growing significant cities and second-tier cities. India comes second only to China in terms of large-scale urbanisation, with 127 million urban population added in the period between 2000 and 2014. However, India's per capita spending on infrastructure was just $17, while China, during the same period, spent $116 per capita (Dobbs and Sankhe, 2010). Even though recent comparisons on infrastructure spending between the two countries is unavailable, the stark gap in spending has already set India back by several decades.

In recent years India's policymakers have realised the potential impact of urbanisation on positive economic development and urban regeneration (Tewari and Godfrey, 2016). In the last few years, the government of India has launched a slew of initiatives to promote liveability in Indian cities including the Smart Cities Mission, Clean India Mission (Swachh Bharat Abhiyan), 500 Cities Fund, Make in India, Heritage Cities and other Urban infrastructure programs. This large-scale urban intervention is both appropriate and timely. Mohan and Dasgupta (2004) state that nothing better could signify the surge in India's urbanisation in the last few decades than the creation of million-plus cities that was virtually zero in 1950 to three cities by the turn of the century.

India's urbanisation has a history covering five millenniums and four phases namely – the Pre-feudal(ancient) period, established the administrative, cultural basis, the feudal phase (medieval) which set up the political-military and economic base; the colonial (modern) phase which resulted in an exploitative capitalist base; and the post-colonial (contemporary) stage which led to a capitalist-welfare base (Krishan and Singh, 1993). Historically, in most modern cities, any significant wave of urbanisation has placed an enormous strain on the cities' infrastructure, built forms, ecosystems, and human services and administration. This has led to the accumulation of already existing problems such as increased energy use and associated greenhouse gas emissions, air and water pollution, and haphazard land uses resulting in incongruous urban planning and design, increased transport needs and yet insufficient mobility and accessibility, traffic congestion, lack of social cohesion, community disruption, reduced public health and safety, to name a few. These issues cause a vicious cycle of social, economic, and environmental degradation, and together with outdated infrastructure (Colldahl et al., 2013) significantly reduce the quality of life in cities.

The urban governance, guided by the Constitution of India, functions operates under a three-tier hierarchical structure (see Figure 3.1). The Union government at the top provides the policy direction, with the governing bodies of state and union territories forming the second tier and undertaking governance of projects. The urban and rural governmental bodies on the bottom tier are responsible for land use, water, roads, economic development, and urban poverty alleviation.

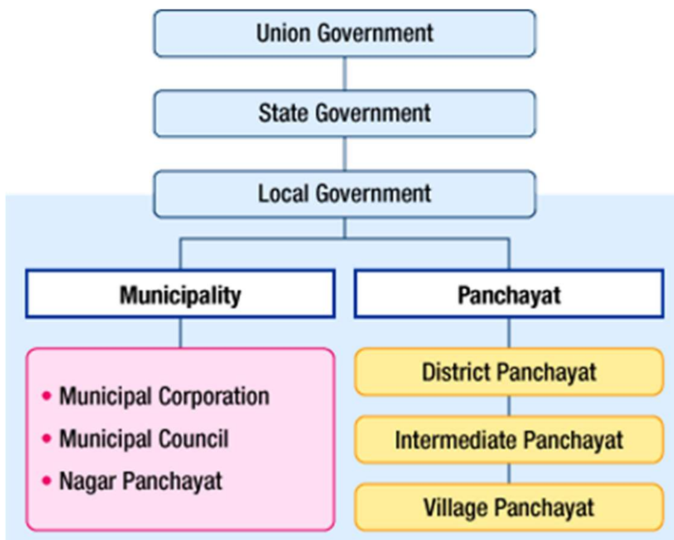

Figure 3. 1: Administrative hierarchy in India

Source: (Biswas, 2016)

The country currently has 28 states and nine union territories (see Figure 3.2), following the changes to the administrative map of India in October 2019.

***Figure 3. 2: Political Map of India, 2019*[1]**

Source: Maps of India (2019)

Amidst this chaos of unprecedented urbanisation, there were several gaps in the attempts towards development for achieving sustainable urban development in India.

[1] This political map authorised by the Government of India will differ from international maps due to the existing border disputes with neighbouring countries. However, this is the only outline map accepted by the Government of India. In this thesis, there could be other maps of India derived from sources outside of India, that may not comply with this requirement.

One such major urban infrastructure development scheme post-independence is the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), which failed to meet several vital milestones (Kundu, 2014). Several reasons can be cited, such as an ambiguous regulatory system, the lack of devolution of power to the local government, and the view of regulation as a limitation rather than a developmental tool. JNNURM's lack of achievement as an effective city-building program us a result of restricted decision making at the local government level (Kundu, 2014). Following the end of JNNURM mission in April 2014, after a decade of its operation as the primary countrywide urban development scheme, the government successively launched four primary urban-centric development schemes from late 2014. The Clean India campaign (Swachh Bharat) was the first mission initiated, followed by AMRUT (Atal Mission for Rejuvenation and Urban Transformation), Housing for All by 2022, and the Smart Cities Mission (SCM). The fact that the SCM has garnered more attention and therefore attracted more funding than the other programs launched simultaneously, could partially be due to the mission's technology-centric approach (Judge Ahluwalia, 2017). AMRUT is regarded as a replacement for the earlier JNNURM mission, while the SCM is the flagship as well as an umbrella project of the Union government of India, that ties together several of the urban initiatives launched post-2015.

Since gaining independence in 1947 from the colonial powers, India's urban agenda appears in three phases- the first three five-year plans primarily focussed on housing provision, clearing slums and overall rehabilitation. The master plan approach adopted by policymakers resulted in low-density settlements built at a considerable cost. The following three plans, viz., fourth, fifth and sixth five-year plans, took a transitionary stance of redevelopment and up-grading of slums, balancing regional development and small to mid-sized towns along with containing the expansion of metropolitan cities. The subsequent 7th to 11th five-year plans reflected the policy stance of economic liberalisation that was instrumental in linking urban growth and its economic development with that of employment opportunities. The economic liberalisation paved the way for improved authority for urban local bodies (ULB) and therefore increased accountability that was instrumental in moving towards developing a market-based financing regime (Batra, 2009). A more detailed overview of how the city and town planning developed during the various five-year period phases is discussed more in detail in section 3.4. Despite putting in place a structured plan at the central government level, urban development was slow-paced and mired with issues that have left most Indian cities facing several inadequacies even to the current day. Some of these inadequacies are evident from the World Economic Forum's report (see Figure 3.3).

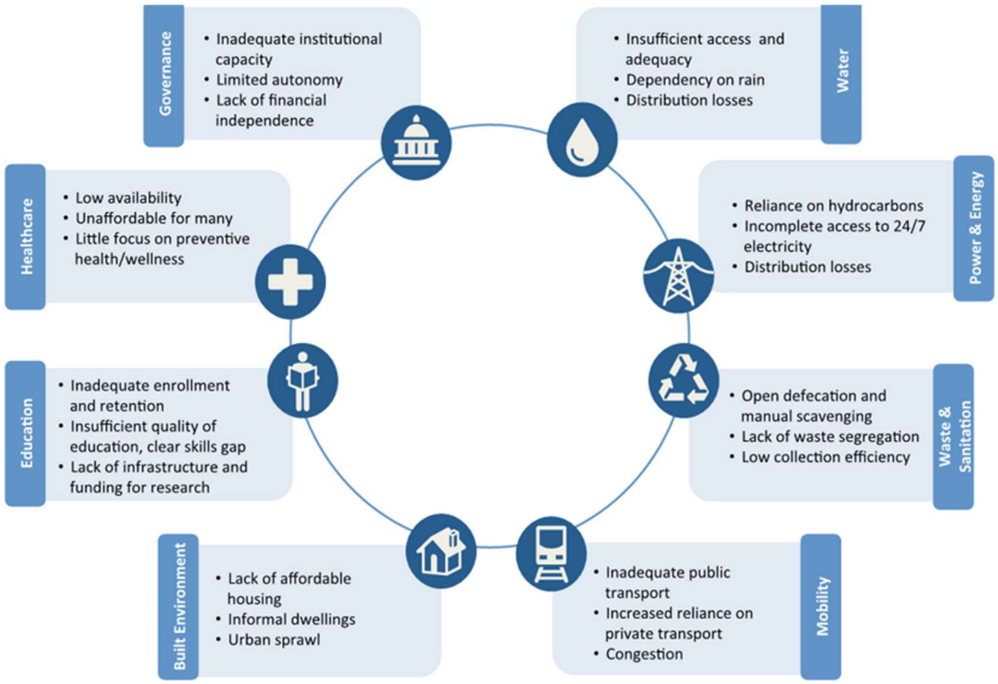

Figure 3. 3: The Challenges in Urban India

Source: World Economic Forum (2016)

The challenges in the water sector of urban India include a reduction in water reserves due to population growth and urbanisation, shortage of safe drinking water, poor condition of pipelines leading to wastage in distribution networks and insufficient mechanism to harness rainwater in a water-stressed nation. The power and energy sector faces difficulties such as non-achievement of 100 % electricity distribution (93.9 %), distribution leakages and over-reliance on coal and petroleum products for power generation, which also has a substantial environmental impact. Waste and sanitation is another major area of threat due to persisting open defecation, lack of toilets in all households especially among the urban poor and smaller cities, absence of sewer connection in half the houses even in major cities, low %age of waste segregation and indifference to waste management by the citizens, which leads to reduced waste disposal practices. Inadequate public transport options due to transport infrastructure not keeping up with the demand have led to over congestion and high reliance on private vehicles like two-wheelers and cars. Likewise, in the built sector, the city and town planning has not kept abreast with the population and demographics shift, leading to urban sprawl and unplanned development along the fringes of almost all cities across the country. The increased real estate prices have also decreased the availability of affordable housing in most cities, which has indirectly contributed to the establishment of informal settlements due to the high %age of rural-urban migration (World Economic Forum, 2016). Though some of the above issues are due to economy, governance, lack of infrastructure spending and social factors, still a great many of the problems listed are also due to poor planning practices in cities and towns. Therefore, it is imperative to investigate India's planning history and current planning and design traditions to gain a deeper understanding of the shortcomings, as discussed in the following sections.

3.3 Design and planning traditions in Indian cities

Watson (2015) highlights the similarities between India's smart city mission and the entrepreneurial urbanism in some African cities. The glossy vision of perfect glass towers, landscaped lawns and freeways are conjured upon and sold to wide-eyed citizens in both cases, even though necessary infrastructure is inadequate at best. Bhan (2014) places a counterview to Watson's claims that Indian cities have had the continued yearning to replicate the 'aesthetics inter-referencing' of Shanghai, Dubai and Singapore. The aspiration is not to replicate the built environment and the economic life but also in the expression the advanced cities present of control and organisation, a reflection of good governance in those urban areas. While Watson's view sounds pessimistic, it is often the case with developments, especially in the cities of the global south, where the lack of accountability often leads to unfulfilled promises. At the same time, the SCM reflects the several years of conscious yearning for better cities. Having discussed the urban challenges in Indian cities in the previous section, it is important to look in more detail at how urban and town planning as well design, are traditionally addressed in India. This would provide an understanding of the current state of planning and design practices, thereby emphasising the need for a greater role for place-based design in India's SCM.

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Carmona (2003) identify urban designers, architects and landscape architects as professionals who consciously shape places. They also identify other contributors to this process, such as community members, politicians, businesses, civic administrators, investors etc., who have a more significant influence on the city without necessarily being aware of it. This diverse set of stakeholders with varying levels of consciousness who influences the 'place-shaping' process are equally and often more critical in determining the shaping of the built environment. However, in Indian cities, the role of urban designers is often limited or even non-existent in some cases. As seen in the previous section, there were numerous shortcomings in urban planning that also contributed to the infrastructure issues. Due to the absence of concerted planning efforts, urban design is not a priority in most Indian cities. Similarly, urban and town planning operate through policy and code-based regulations in India, urban design control for new developments is almost non-existent in the policy documents (Mehrotra, 2000). Given this context, it is essential to delve into the historical planning and design traditions in Indian cities to gain a deeper perspective on these issues. Section 3.2.1 touches upon the into the Pre-feudal(ancient), feudal (medieval) periods and the colonial (modern) phase while section 3.2.2 discusses.

3.3.1 The Pre-Independence era – ancient India

Smith (2006) identifies three distinct periods defining the urbanisation phases namely; Indus Valley spanning between 2500-1900 BC; the early historical period from third century BC to fourth century AD (ancient); and the medieval period after the ninth century AD onwards. Town and urban planning in India has its roots in the Mohenjo-Daro and Harappa civilisations, with Fatehpur Sikri and Shahjahanabad being early examples of planned cities during the Mughal rule (Ansari, 2009). Historic Indian classical literature often referred to grand cities like Mathura, Ayodhya, Indraprastha, Dwaraka, Ayodhya and Hastinapura, as part of the various empires that they housed. The Indus Valley civilisation was quintessentially one of the four prehistoric civilisations in the world which included the Sumerian, Mayan and Egyptian civilisations. The Indus settlements were predominantly urban and demonstrated extensive use of burnt bricks for house construction, employ weights and measurement systems, domesticate animals and grow food crops. These practices and the presence of merchant traders signified the emergence of urbanisation in India's history (Patel and Goyal, 2018). The over 2000-year-old history of India documented by historians in the form of civilisations and associated systems has town planning as a critical feature. The most prominent among this civilisation is in the Indus Valley region dating back to 2500 BC (Raina et al.,2008). While some researchers believe that recorded evidence on the first signs of urbanisation in the Indus valley exists from around 3000 BCE (Violatti, 2013), some of the most ancient cities listed in this region include Dholavira, Kalibangan, Rupar, Rakhigarhi and Lothal (see Figure 3.4). These cities are presently located in the current-day Indian states of Punjab, Rajasthan, Haryana and Gujarat.

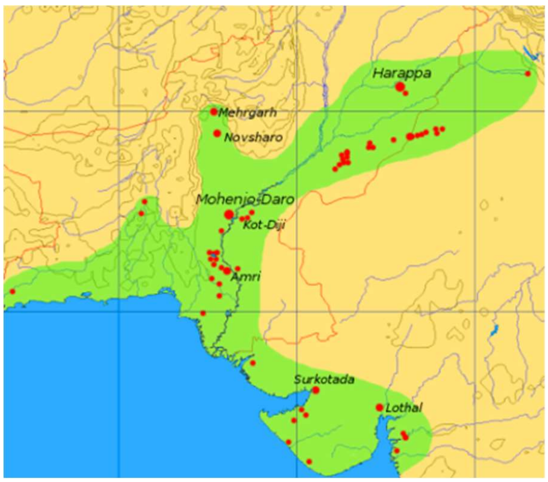

Figure 3. 4: Settlements of Indus Valley Civilization
Source: Violatti (2013)

Figure 3. 5: Street layout in Mohenjo-Daro
Source: The British Museum (n.d.)

The two most significant and most researched cities of the Indus Valley civilisation are Harappa and Mohenjadaro, which are in modern-day Pakistan. These cities had a population of roughly 23000-40000 people residing in an area of approximately one square kilometre. The street layouts in these locations invariably formed a grid-iron pattern (see Figure 3.5), which is one of the earliest instances of the use of this pattern in town planning. Aligned with the North-South cardinal directions, the streets were had an approximate width of 9 meters and sub-divided into 12 blocks, each measuring 365mx244m (Raina et al.,2008). The houses here were predominantly two-storied, constructed with burnt bricks around a courtyard and had sanitation arrangements, as well as streets with drainage and covered sewers with soak pits at regular intervals (Adams, 2004).

In addition to the above archaeological finds, the Vedic period, between 1500 and 800 BCE, forms part of the earliest record of Indian culture. Ancient Hindu literature so-called the "Vedas" written during this period had several notable inscriptions on the rules of town planning. One of the treatises called "*Visvakarmaprakasa*", attributed to the divine architect *Visvakarma*, sets out the critical regulations to be followed. Some of them as interpreted by Dutt (1925) in his book 'Town Planning in Ancient India' are listed below

- First layout the town and then only plan the houses. Violation of this rule portends and brings evil
- First, plan trees and erect the premises after that; otherwise, they will not look graceful and seemly.
- Footpaths to be as comprehensive as one-third of the breadth of the house
- All houses to face the royal road and the narrow lanes (service roads) at the back to allow for removal of nightsoil.
- The space between any two houses had to be four padas or three padas (feet)

Planning guidelines like prioritising town planning before housing layouts, trees along avenues, wide footpaths, houses facing the road, ensuring eyes on the street and enough setback between buildings are relevant even to this day. The guidelines are a testament to the sound planning principles followed during the period of ancient Indian civilisation. In addition to the above Vedic manual, Kautilya's Arth Sastra and Manasara Silpa Sastra were other ancient scripts that laid out rules with a scientific approach to town planning (Thooyavan, 2005). The other significant periods of city building in India's history happened during the Mauryan Empire, led by the propagation of Buddhism and Jainism in the period between 400 BC and 1300 AD. Likewise, the Chola period (849 -1279 AD) in South India saw the evolution of temple urbanism. With the temple being the focal point of the settlement, and the settlements arranged in concentric squares around the temples(Raina et al., 2008). For instance, Thanjavur in present-day Tamil Nadu was a metropolitan city during the medieval period (Sridharan, 2016). Similarly, the southern Indian temple towns of Madurai with Meenakshi Amman temple at the centre (see Figure 3.6), along with Kanchipuram and Srirangam are manifestations of the metropolitan approach.

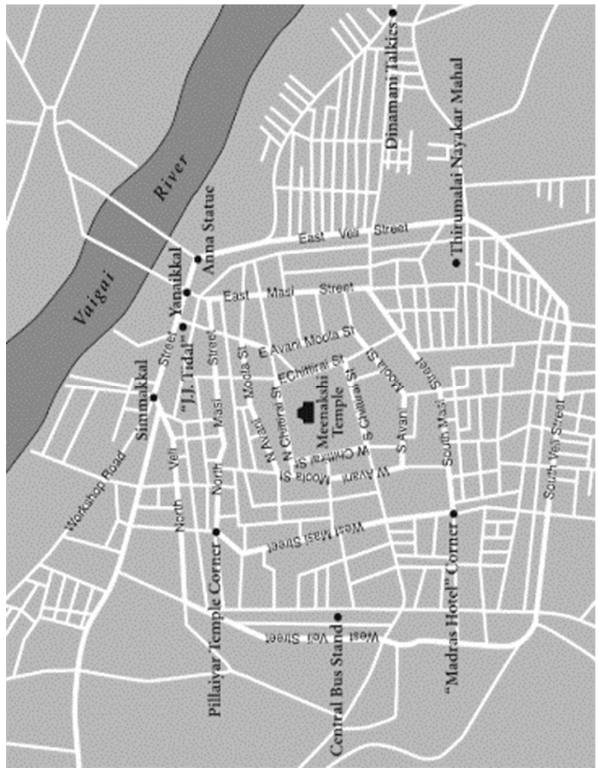

Figure 3. 6: Layout of Madurai city in Tamil Nadu

Source: (Bate, 2009)

The Mughal era, which began in the 16^{th} century, brought about a long-lasting change in the built environment of Indian cities and towns, for almost the next 300 years (Thooyavan, 2005). The Mughals planned several cities during this period; Delhi, Lahore, Fatehpur Sikri, Varanasi, Mathura, Patna and Ahmedabad are some of the cities built during this period. The Mughal architecture and city planning had its roots in central Asia, with a unique architectural style developed over the period, that became symbolic to the Indian sub-continent. Several buildings and some cities still bear testimony to the monumentality and architectural grandness of this period. Raina et al. (2008) observes the following planning characteristics of Fatehpur Sikri

- City orientation towards NE to SW with predominant building orientation along North to South
- Three-tier planning with a mosque on tier one, the royal palaces in tier two and public complex on tier three

- Courtyards, verandas, pavilions and terraces provided ensured cross-ventilation and natural lighting
- The layout of plots followed geometric shapes
- Well planned water and drainage systems with rainwater collection through tanks and reservoirs
- Gardens were an integral part of the overall plan

The fall of the Mughal Empire brought about discontinuity in the town planning tradition of the sub-continent, which also set the start of a different course with the colonisation of the country by the British Empire under the East India Company. The British rulers implemented the transition towards European methods of planning and development controls (Nallathiga, 2009). The period under the British colonial rule also prioritised the implementation of facilities like piped water, sewage systems, planned residential sectors and shopping areas, exclusively for the British officers. They also set about constructing administrative offices, commercial establishments like industries, port towns for shipping goods to England, railway colonies, military cantonments and hill stations for the recuperation of the officers from the harsh Indian summer. The colonial period was also instrumental in initiating local municipal governments, set up by the works of Lord Rippon in 1882 (Patel and Goyal, 2018), thereby laying the foundations for future Indian cities. Patrick Geddes, the Scottish environmentalist and planner, arrived in India in 1914 right around the time the First World War broke out and spent the next ten years promoting town planning principles as an independent consultant. He propagated the idea of 'garden villages' modelled along the same lines of Ebenezer Howard's 'Garden cities of tomorrow'. Though cooperative home building cities widely adopted the ideas, the residents, however, tended to adopt the more traditional use of spaces within their compounds (Scriver and Srivastava, 2015).

The era of British planning in India left behind both positive and negative impacts on cities in India. Though the primary aim of the new rulers was to evolve the cities in such a way that they met the economic needs of the Empire, the process did institute organisation of the settlements, building new infrastructure and legalising the planning framework. The three cities of Madras (1644), Bombay (1661) and Calcutta (1690) were built from the ground up, mainly for British occupancy. The first town planning act was passed during this period, namely, the Bombay Town Planning Act of 1915 that set rules for zoning, building regulations, revenue generation for public works and land acquisition (Spodek, 2013). Such was the impact of the British town planning experience that some planners believe that it greatly influenced the way Indian planners conceive the city, even almost 50 years post gaining independence (Menon, 1997). Such was the allure of the western-based urban models that adoption happened without testing their appropriateness towards local conditions. However, although India's town planning roots are ancient, the British colonisation was instrumental in bringing Indian cities into the modern period.

3.3.2 The post-Independence era – modern India

"To build a city is something happy to think of. To create a new town is itself a happy thing. There cannot be a greater joy than to create; it is almost godlike to create. To be associated, therefore, with the construction of a city has been a thing which I appreciate the most. "- Jawaharlal Nehru, India's first prime minister post-independence.

Post-independence, the drive to project India as the new nation led to the planning and construction of new cities like Chandigarh, Gandhi Nagar and Bhubaneshwar, as new state capitals. Beyond these capital building initiatives and few industrial towns that were developed with foreign collaboration, there was a policy vacuum, as urbanisation was not considered as a tool for economic development (Sridharan, 2016). This perception of urbanisation post-independence underwent a slow and steady change, as evident from the language of the various planning commissions. The 10th Planning Commission in 2002 stated that attitudes towards urban development across India are seen both as an unavoidable evil or in contrast, as engines of growth. However, it credits urbanisation as essential causation of economic growth, post-liberalisation measures of the 1980s and 1990s. A decade later, the 12th Planning commission in 2012 indicated that urbanisation was a necessity to India's economic growth, with the strengthening of rural-urban links as a means to promote growth in rural regions. The resolution for the forming of NITI Aayog in 2015 acknowledged urbanisation as irreversible and therefore stressed the need to use modern technology to create better spaces and to draw on the economic benefits that it would offer (Bhattacharya et al., 2015). From Figure 3.7, it is evident that the population growth during the first six five-year plans growth was gradual, and then rose exponentially for the second set of five-year plans, for the same length of time. Despite this, the first principal nation-wide urban development mission, namely JNNURM, was introduced only during the tenth five-year plan, clearly indicating the delay in urban interventions at the national level.

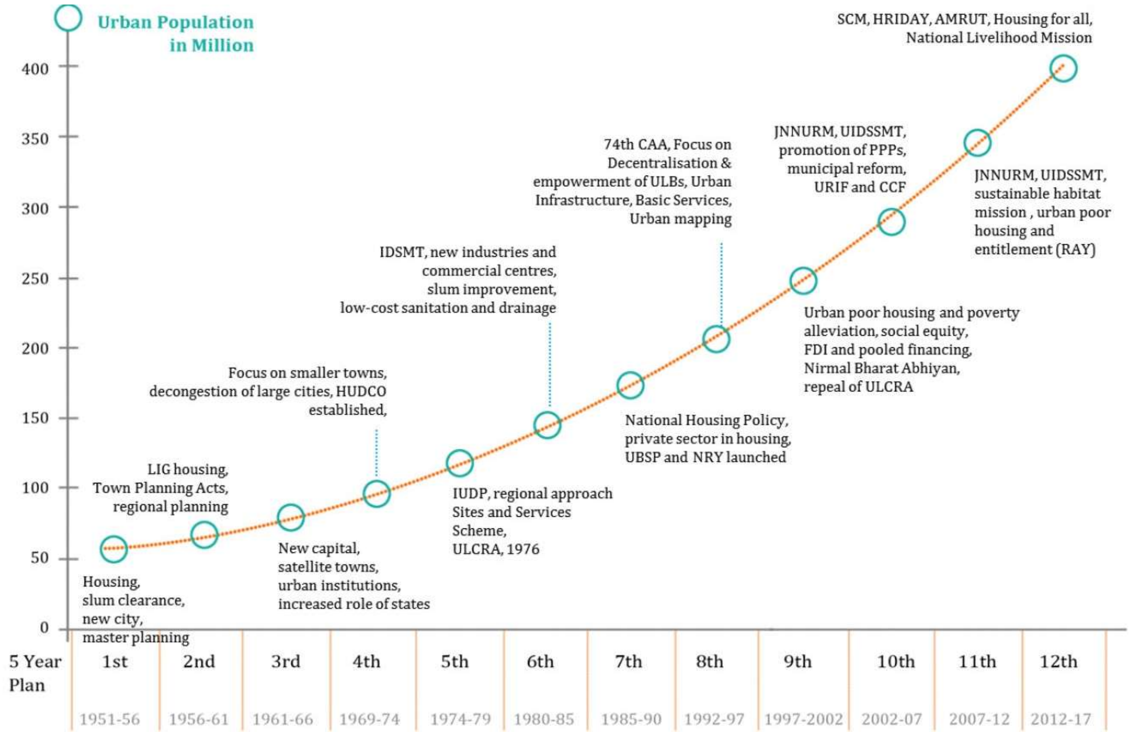

Figure 3. 7: Urban-related development focus in India's five-year plans

Source: Bhattacharya et al. (2015)

Most cities in emerging economies, especially in Asia, struggle from common issues like infrastructure deficiencies, pollution, congestion and informal settlements (Dahiya, 2012). As urban and town planning in India is mainly top-down and highly centralised (see Figure 3.8), an integrated urban policy at the national level will help in setting focus and growth directions for these large city-regions. In India, urban and town planning adapts a mainly centralised and top-down approach. Though urban and town planning falls within the purview of the state governments, the state planning commissions/boards thinktanks have failed to come up with integrated state-wide development strategies and are highly reliant on the planning commission of India (Bhagat, 2014), to set policy priorities. There is varying information on the classification of the cities in India. The Census of India (2011b), considers population, density and employment category as the key categories for classification. The urban areas are categorised either as

- statutory towns – which is a municipality, corporation, cantonment board or a notified town area committee, or
- census towns – an area with a minimum population of 5000, with at least 75 % of the population involved in non-agricultural occupations and with a population density of at least 400 persons per sq.km.

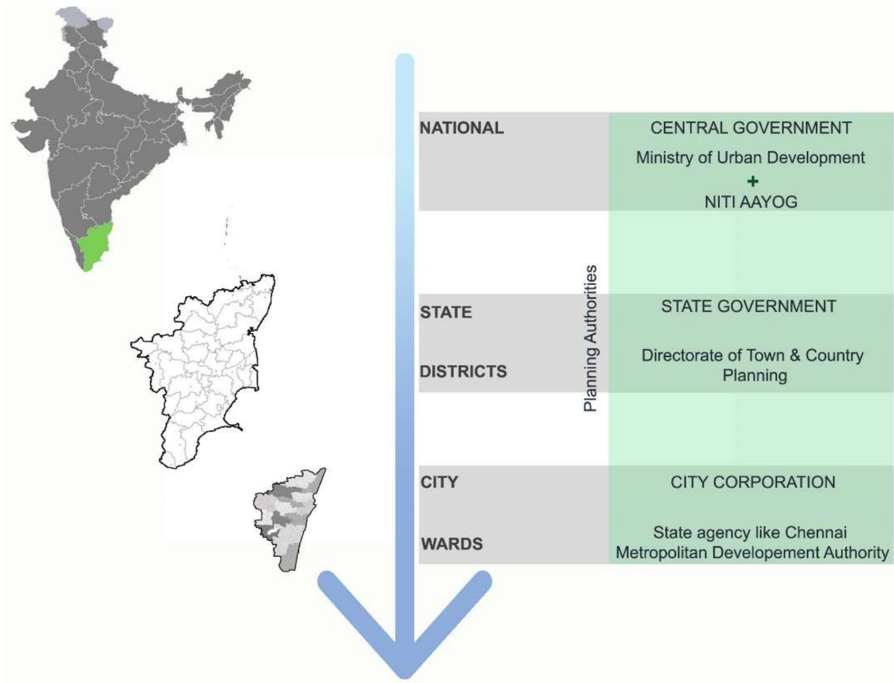

Figure 3. 8: Different scales of planning in India

Source: Adapted from Hochart (2014)

The urban agglomerations/cities /towns further are grouped into six different classes or tiers. Cities with a population of 100,000 and above come under Class I cities, between 50,000 and 99,999 as Class II, between 20,000 and 49,999 as Class III between 10,000 and 19,999 Class IV; between 5,000 and 9,999 as Class V and finally cities with less than 5000 population is listed as Class VI cities. While the first four classifications refer to city areas, class four refers to semi-urban centres, and classes five and six relate to rural centres. Under this method, New Delhi, Greater Mumbai and, Kolkata are classified as megacities, with the remaining cities either classified as million-plus urban agglomerations and class I towns based on population. (Census of India, 2011b).

Another different city classification is used by central government departments to allocate grants for employee rental allowances. Based on the cost of living in different cities, a three-tier system is used in this method (GOI, 2015). Hyderabad, Delhi. Ahmedabad, Bengaluru, Greater Mumbai, Pune, Chennai and Kolkata are the only cities that qualify as tier-I or ‘X’ cities as per the notification. Around 89 cities are identified as tier-II cities or ‘Ý’ cities, and the ‘remaining cities are classified as tier-III cities. Subsequently, in 2015, the Urban Regional Development Plans Formulation and Implementation (URDPFI) guidelines were released by the Town and Country Planning Organisation (TACPO), which modified the census classification of urban settlements (see Table 3.1). In this latest document, Megapolis is the first level cities in which Greater Mumbai, Delhi and Kolkata are identified under this category, with a population of more than one crore (10 million). Followed by the five cities of Chennai, Bengaluru, Hyderabad, Ahmedabad and Pune classified as Metropolitan Cities- II (population 5-10 million). Cities with a population between one and five million are classified as Metropolitan Cities-II (TACPO, 2015)

Table 3. 1: Classification of urban settlements in India in URDPFI

Source: TACPO (2015)

S.No.	Classification	Sub-category	Population Range	Governing Local Authority	Number of Cities as per Census of India, 2011
1	Small Town*	Small Town I	5,000 - 20,000	Nagar Panchayat	7467
		Small Town II	20,000- 50,000	Nagar Panchayat/ Municipal Council	
2	Medium Town	Medium Town I	50,000 to 1,00,000	Municipal Council	
		Medium Town II	1 lakh to 5 lakh	Municipal Council	372
3	Large City	--	5 lakh to 10 lakh	Municipal Corporation	43
4	Metropolitan City	Metropolitan City I	10 lakh to 50 lakh	Municipal Corporation/ Metropolitan Planning Committee	45
		Metropolitan City II	50 lakh to 1 Crore	- Same -	5
5	Megapolis	--	More than 1 Crore	- Same -	3

Considering all the evidence, the current classification of cities in India is inconsistent as different agencies under the central government classify varyingly. Even the TACPO classification is inaccurate in some cases on comparison with international data. For instance, the URDPFI ranks Chennai as a metropolitan-II level city with under 10 million population, while the report on the World Cities by the United Nations (2018) considers Chennai to have crossed the mark in 2018. Therefore, this positions Chennai as one of the five Indian megacities and one among the thirty-three megacities in the world. The reason in the contradictory claims is that India's urban areas classification varies widely from most western counterparts and is considered more restrictive (Abhishek et al. 2017). Redrawing municipal boundaries along the redefined edges of the larger metropolises is a highly delayed process in Indian cities. Sometimes the shift in city boundary does not get updated till the next census, which is made once in ten years. The delay often leads to numerous issues like providing essential services to the peri-urban communities, loss of revenue to city corporation and more importantly, population not reflecting the actual numbers.

Institutionalised in 1951, the Planning Commission has been the primary body for a policy framework for India, including urban development, setting out five-year plans. The 12th five-year plan which ended in 2017 was the last in the series of plans, and NITI Aayog (National Institution for Transforming India) launched a three-year action plan beginning April 1, 2017. The institution is also expected to prepare a 15-year vision document and a seven-year strategy to outline the developmental works for the country(Press Trust of India (PTI), 2017). Haque and Patel (2018) in their study revealed that close to 67 % of the urban areas in India including the four major metropolitan cities, the core area of the cities are declining in population growth while the peripheral areas are experiencing an accelerated growth pattern. While Mumbai has seven times higher growth rate compared to the city's core, Chennai had ten times the growth rate, and Kolkata had six times the rate, during the 2001-2011 period. The trend is synonymous with other major cities such as Pune, Kanpur, Allahabad, Indore and Nagpur, to name a few.

The first urban planning policy by the Central government was the launch of the Jawaharlal Nehru Urban Renewal Mission (JNNURM) in December 2005. The mission targeted to improve the essential city services, including housing supply, urban sanitation, water supply, road network, and transport, primarily focused on delivering to the urban poor. This mission merged with or replaced several other earlier schemes such as the Integrated Development of Small and Medium Towns (IDSMT) (1979-80), Mega City (1993), National Slum Development Programme (1996) and Valmiki Ambedkar Awas Yojana (2001) (Bhagat, 2015:5). The other cities and towns not catered for under the JNNURM were brought within the aegis of the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) along with the Integrated Housing and Slum Development Programme (IHSDP) (Patel and Goyal, 2018). Bhagat (2014) presents a detailed historical perspective on the urban policies and programmes in India, which identifies the critical urban development initiatives during each of the plan periods. The efforts outlining key initiatives are compiled in the table below (see Table 3.2).

Table 3. 2: Historical urban development initiatives in India

Source: Adapted from Bhagat (2014)

PLAN	PERIOD	KEY URBAN DEVELOPMENT INITIATIVES
First Five-Year Plan	1951-1956	- Establishment of Town and Country planning organisation
Second Five-Year Plan	1956-1961	- National Building Organisation - Delhi Development Authority - State governments advised enacting town and country planning legislation
Third Five Year Plan	1961-1966	- Advised planning of cities and towns to adopt a regional approach - Emphasised urban land regulation and preparation of master plans for major cities - Most states legislated town planning legislation based on British town planning principles
Fourth Five-Year Plan	1969-1974	- Continued on the third plan's recommendations - Development plans for 72 urban centres were prepared - Regional studies of Delhi, Greater Bombay and Calcutta - Planning for new capital cities of Chandigarh, Gandhinagar, Bhopal and Bhubaneshwar
Fifth Five-Year Plan	1974-1979	- Urban Land Act (Ceiling and Regulation) passed in 1976 - Housing and Urban Development Corporation (HUDCO) established in 1970 to fund projects by Urban Local Bodies (ULB) - The individual financial commitment for integrated urban development to major cities continued from the fourth plan, with Kolkata, Mumbai and Chennai benefitting
Sixth Five-Year Plan	1980-1985	- Development of small and medium-sized towns emphasised

		- Integrated Development of Small and Medium Towns (IDMST) launched in 1979, for development of 200 small and medium towns
Seventh Five-Year Plan	1985-1990	- National Commission on Urbanisation report submitted in 1988 - Bill passed in parliament in 1992 granting constitutional status to urban local bodies, establishing the three-tier governance structure
Eighth Five-Year Plan	1993-1994	- Mega-City Scheme introduced for the five cities of Mumbai, Chennai, Calcutta, Bangalore and Hyderabad - IDSMT scheme was overhauled to improve small and medium towns and divert growth from big cities -Indicated that other sources of funding should be explored to remove funding constraints that limit project implementation
Ninth Five-Year Plan	1997-2002	- Advised preparation of state urbanisation strategy to synchronise various urban development programmes - Emphasised decentralisation and financial autonomy of ULBs - Nehru Rozgar Yojana (NRY-1989), Urban Basic Services for the Poor (UBSP-1990) and Prime Minister's Integrated Urban Poverty Eradication Programme (PMIUPEP-1995) were merged to form Swarna Jayanti Shahari Rozgar Yojana (SJSRY) in 1997 along with National Slum Development Programme (NSDP)
Tenth Five-Year Plan	2002-2007	- Acknowledged urbanisation as a critical accelerant of the economic growth, post liberalisation of the economy - Stated that IDSMT, Megacity and NSDP projects delivered less than desired outcomes, mainly due to procedural and financial issues - Valmiki Ambedkar Awas Yojana (VAMBAY) initiated in 2001 for providing homes for people below the poverty line - Stressed the institutional building of ULBs as a critical requirement of urban development
Eleventh Five-Year Plan	2007-2012	- Jawaharlal Nehru National Urban Renewal Mission launched in 2005 in 63 mission cities, to develop infrastructure including housing, water supply, sanitation, road network, transport and development of inner-city areas

		- Earlier programmes of Mega City, IDSMT, NSDP and VAMBAY, merged with JNNURM - A new programme called the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) launched to cover non-mission cities and towns - JNNURM mandated cities to propose a long-term vision plan and formulate a city development plan (CDP)
Twelfth Five Year Plan	2012-2017	- Consolidated JNNURM and broader role proposed - Barriers to JNNURM identified as a failure to regularise urban planning in many cities, slow implementation, delay in securing land and obtaining regulatory approvals. - Rajiv Awas Yojana (RAY) programme, to support states to upgrade slums and to create slum-free India, launched as a pilot in 2011 and then approved for period 2013-2022.

From the table, the increasing policy focus toward city and town planning is evident, especially after the fourth five-year plan. Some crucial initiatives like building new capital cities, regional studies on major cities and preparation of urban development plans for 72 urban areas were all initiated during this phase. The third five-year plan is a significant milestone in the urban policymaking of the country for legislating town planning policy and for commencing master plan works. However, up until the fifth five-year plan, the emphasis was on the development of the major cities, even though every single plan insisted on the importance of developing small and medium cities and towns. Master Plan of Delhi Development Authority was the first effort in modern India that served as a model for city planning in other parts of the country. Some of the key elements in the various five-year plans related to planning include that the opening up of India's economy or what is referred to as the 'liberalisation' era that commenced in 1991, had an impact on India's urban policy, which was reflected in the eighth five-year plan. The plan recognised economic development as the stimulus for urban growth and encouraged a public-private partnership model for urban development. The Planning Commission of India and the Ministry of Urban development jointly launched the 1993-94 'Mega City Scheme' to improve urban infrastructure in the major cities of Mumbai, Calcutta, (currently Kolkata) Chennai, Bangalore (currently Bengaluru) and Hyderabad. It was also the period in which the 74th constitutional amendment was brought forth, giving more administrative powers to urban local bodies (ULB) (Batra, 2009).

The 12^{th} five-year plan laid great emphasis on promoting public transport in major cities along with intelligent transport systems in place. Under the Urban Infrastructure and governance scheme in JNNURM, bus rapid transit system projects were approved (Alam and Ahmed, 2013). The 73^{rd} and 74^{th} constitutional amendments in India recommended the establishment of separately elected bodies known as the Urban Local Bodies (ULBs) and Rural Local Bodies (RLBs). In most states, based on population size and income, the urban local bodies are differentiated either as a municipal corporation, municipality or town panchayat (Woiwode, 2017). The JnNURM mission was successful in promoting eight e-governance strategies including the issue of birth and death certification, property title certification, property tax, payroll and personnel, e-procurement, building plan approvals, payments for utilities such as water and sewerage, a public grievance address system, and issuance of trade licences and tenders for project works.

Shaw (1996) notes that barring the major metropolitan cities and a few other urban centres, most small cities and towns in India have undergone an organic growth of their own, without significant interventions from the urban policies and programmes. The failures of JnNURM, the major city building mission, was acknowledged in the twelfth five-year period. This followed the closure of the planning commission, with the reinstatement of a new policy think tank named NITI Aayog in 2017. Although there were significant urban developments that happened during the post-colonial period, the progress was slow (Bhagat, 2014) to keep up with the increasing population growth. Even though there were several policy initiatives, possibly due to high reliance on central government agencies, it did not deliver the required changes at the local city/town level. Given the policy context, it is necessary to look in detail at the planning and design failures in Indian cities after more than seven decades of gaining independence. This will be the focus area of the next section.

3.4 Contemporary urban planning and design challenges

Jain (2010) states that given the diverse, multi-layered social, economic and cultural variations in India, it is not possible to have a homogenous and standardised model of urban development in India. The current day planning process in India revolves around the role of local bodies acting as a 'provider' instead of a 'facilitator' to bring together several agencies. Urban planning does not work in isolation but is built upon by political, social, infrastructure and administrative realities. Private sector participation in city and infrastructure developments must be strategically leveraged for the benefit of all. The balance of the various components and stakeholders is essential to the city building process. Consequently, the planning approach has moved forward from simple spatial planning that would also meet housing, spatial and infrastructure demands to include aspiration planning (see Figure 3.9). Effective participatory planning can bring about the change and the improvements that could be negotiated between various stakeholders. Jain (2010) further states that the following are the fundamental sustainability principles that are critical to city design:

Jobs: location of employment sites within communities for an easy commute

Corridors: transit routes along high-density commercial and residential corridors

Walkability: Interconnected street systems that link available services with the residents in the community

Greenspace: Connecting people with nature and act as spaces for recreation

Infrastructure: Reduced infrastructure costs through recycling and a clear focus on the conservation of natural resources for better environmental impact.

Housing: Range of housing types that would support citizens with different economic status while still permit residents to have equal access to all services

Management and Maintenance: Managing smart growth of land to create a smart and compact city that is both flexible and has ample opportunities for economic development.

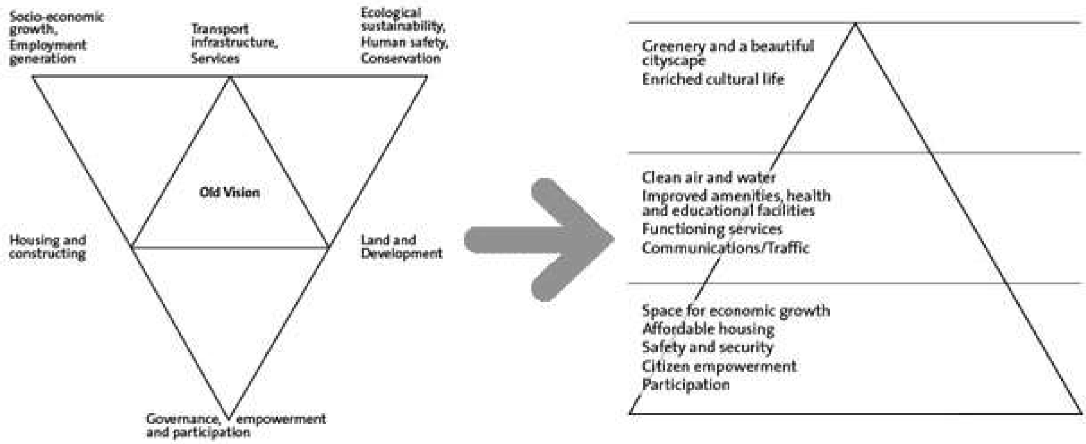

Figure 3. 9: Shift from the new paradigm to an aspiration pyramid

Source: Jain (2010)

The above aspirational model of planning approach with a sustainability focus, improved community participation, increased role of local governments as a facilitating agency and greater involvement of public sector, all augurs well for Indian cities of the future. However, these research outcomes frequently do not transfer into real outcomes in most Indian cities. One significant theme that emerges from the policy study in the last section and the above is the limited role of local governments leading to several failures. As a result, significant urban planning and design issues became the norm in Indian cities. The challenges identified from the literature review is discussed in this section.

3.4.1 Reliance on Master Plan mechanism

The current town and urban planning in India are premised on the Town and Country Planning Act of the United Kingdom that has its primary focus on land use zoning. Although many countries around the world conventionally adopt this approach, there has been a growing number of countries, including the United Kingdom, that has moved away from the master plan centric developments. Similarly, in recent years there has been a paradigm shift in the way urban transport was considered as a spin-off to land use planning as opposed to the two-way relationship between these two factors. Pethe et al. (2014) state that long-term planning is enacted through Master Plans that prescribes the land use of current and envisaged future boundaries of a city.

However, city planning in India has traditionally dealt with issues in isolation rather than a whole cohesive structure, with parts complementing the whole and with each other. Various urban development schemes both at Central and the state level were developed without a long-term vision and would set the guidelines for the projects.

In India, Master plans are still utilised as a preferred planning tool and generally spans 20-year periods, that presents a road map to the city's future. The preparation of master plans typically takes up to 10 years or much longer as in the case of the city of Mumbai, which took 17 years to be finalised. The master plan preparation process commences with population projection in each urban area, considering factors like average household size, income levels, residential demand and spatial requirements for office, retail, industry etc. However, the main issue with the preparation of master plans in India is that market forces are not considered while defining the economic activities and therefore, a flexible approach is lacking in the plan-making process. Ahluwalia and Mohanty (2014) adopt a hard-line stance on the way that master plans in most cities have restricted their purview only to the city area and has not gone beyond this and considered the metropolitan and regional area as a whole, for a holistic approach. Some of the other common complaints relating to the master plans by various cities include neglecting requirements in low-income households in society during the spatial planning process; a top-down approach that does not involve all stakeholders; and not considering financial implications, which is a crucial deterrent when it comes to land acquisition that hampers project executions.

While master plan based planning models are restrictive in some aspects, Nallathiga (2008) observes that in the last decade, there has been an increased tendency towards the 'metropolitan nation' among Indian city governments. However, as more cities join the metropolitan league, their administrative structures are not necessarily upgraded to enhance the management and service delivery of required civic amenities. There is a lack of coordinated action among the different institutions like the municipal corporations within an enlarged urban agglomeration or between areas that are under transition. This issue is amplified further due to the absence of an integrated metropolitan/regional level plan that helps in coordination, conflict resolution and power-sharing between jurisdictions and institutions.

3.4.2 Lack of urban growth boundary

The current number of five megacities in India, namely Mumbai, New Delhi, Kolkata, Chennai and Bangalore, is expected to rise to seven by the year 2030 (United Nations, 2016). This rapid growth of cities will increasingly widen the existing gap between demand and supply of public infrastructure services across the country (Ahluwalia, 2019). As pointed out by Randhawa and Kumar (2017), the resultant urban sprawl due to congested city cores only leads to degradation of living quality. In Indian cities, the need for looking at the ways fringe areas in the city develop must be recognised.

A decade ago, Roy (2009) presented a telling commentary on the planning failures in the typical 'third-world' mega cities in India, where the urban expansion has been so dramatic that it continually undermines the planners' vision. The spectacular population growth cannot be entirely blamed for all the woes, as the infrastructure needs, and future growth predictions are always invariably underestimated at all levels of government. The effect of insufficient growth projections is illustrated by Roy (2009) using the cases of Bengaluru and Kolkata's planning attempts, where the city infrastructure did not keep up with economic growth. The city of Bengaluru is regarded as India's IT hub, or it is very own Silicon Valley. The thriving economy of the city increased the need for international connectivity and the space constraints of the existing airport, led to the creation of a new international airport in 2008 around 30 km away from the city, with a private partnership. The site was identified to be a future growth centre, but other than establishing a road connection from the city, however, the area did not receive any significant infrastructure spending to realise the grand vision proposed. Roy (2009) identifies this gap as the planning system is at the mercy of private developers rather than a concerted effort by the exclusively created Bengaluru International Airport Area Planning Authority (BIAAPA). In the past decade, the area around the airport has seen haphazard development of several tech parks without much physical infrastructure. The area identified for planning around the airport in 2009 was approximately 1330 sq.km, with a revised plan under preparation by the planning authority (BIAAPA) for an area of roughly 500 sq.km (Bharadwaj, 2018).

Urban growth management strategies adopted from the experiences in the cities of the global north, like urban growth boundaries and land use regulations, have not always delivered similar outcomes in countries of the global south like India, China and Korea. The scale of the developments and the fast pace, along with embedded structural issues are deterrents to this adaptation. However, Tiwari and Jain (2014) propose ways for Geographic Information System (GIS) solutions to contribute to smart urban planning in India by location-based spatial data and visualised scenarios to integrate data with existing applications to assist policymakers and city administrators in making informed decisions. Some of the GIS applications that can be useful include gathering and summarising asset management data, using sensor networks and analytics for better water policy and water management, crime prevention by integrating GPS data and using GPS and RFID sensors to enable seamless communication for emergency response management. Without having a consolidated urban boundary, at least for the major cities, the peri-urban regions will continue to grow, and which will later be engulfed by the city. This constant growth and expansion will continuously shift the centre of the city, leading to underutilisation of built-up area and density, and hence contributing to uneven distribution.

3.4.3 Shortcomings of development regulations

Kapadia (2014) states that western planning practices predominantly shape the planning profession in India. Even though the context surrounding the planning decisions differs vastly in India from its western counterparts, the resultant planning outcomes have been readily accepted and followed without proper due diligence. When the age of suburbia set in, India followed its colonial masters, and single-use zoning became the norm against the already existing ‘mixed-use’ practice in Indian cities. As the caste-system already fragmented Indian society, this planning approach found quick affiliation that led to further fragmentation of the city’s spatial geometry. The creation of ‘gated community’ has been furthermore divisive of the social fabric of cities, causing class categorisation.

Development control regulations in India are governed by land use and zoning laws, site planning and application of building standards. These planning regulations are mandated by specifications of minimum lot sizes and accompanying road widths, maximum floor space index (FSI) and ground coverage, maximum building height or number of floors, minimum setbacks around the building, minimum %age of open space requirement, and minimum parking standards among other requirements (Patel et al., 2017). The average FSI in Indian cities is low compared to international standards. As Ahluwalia and Mohanty (2014) point out the planning regulations in most countries would prescribe higher FSI within the inner city business districts, moderate FSI in nodal sub-centres and lower FSI further away. This is not explicitly followed in Indian cities with most cities having a relatively very low FSI, especially within the central core. This significantly increases the urban sprawl and also, due to comparatively higher rent, drives residents to peripheral low rent areas, in turn contributing to sprawl.

While most Indian cities are overcrowded, the land-use policies restrict high-density built-up floor space in the central areas of the cities, becoming a contributing factor for urban sprawl. A common characteristic is the low density in cities regulated by floor space index (FSI) or floor area ratios (FAR) which place a high restriction on the maximum built-up area per plot. FSI's in Indian cities are generally regarded as very low compared to most economically successful cities in the world. Additional regulations like maximum height specification, plot-coverage restrictions, compulsory setbacks and parking requirements render an overall restrictive approach to urban planning. This places a considerable strain on real estate pricing within prime areas of the city, thereby pushing market prices. Mumbai stands as an example of this case and is consistently named as one of the most expensive real estate destinations in the world. The lack of affordable low-income housing results in the growth of informal settlements as real estate prices are too high for the urban poor and new migrants into the city. The lower-income and middle-income households who wish to own dwellings are pushed further and further away to the periphery of the city, which is devoid of necessary urban infrastructure, has deficiencies in water supply, sewerage and sanitation, and lacks solid waste management facilities as well as having inferior transport connectivity (Tewari and Godfrey, 2016). Policy issues related to one aspect have a compounding effect and impacts several other elements of city planning.

Urban regulators in city governments in India traditionally tend to restrict over density by imposing rigid regulations, which most times lead to gross underutilisation of the serviced urban land. This places a high cost on society, limits the availability of floor area and decreases affordability as the built-up area becomes a premium. The urban fringe areas of Indian cities come under the jurisdiction of the municipal corporations or the town panchayats (Patel et al., 2017). The municipal building byelaws in these areas deal only with the development control requirements of an individual building and do not consider any strategy for the overall public realm. In addition, the byelaws are often flouted due to reasons such as failure to enforce the regulations strictly, lack of workforce to oversee compliance and corruption among officials.

3.4.4 Inclusivity in Planning

One of the key deterrents to inclusive urban planning in Indian cities is the distinction shown towards the urban poor and the nonpoor residents. According to the Census data of 2011, around 65 % of towns in India have reported the presence of towns. Though this is an already high figure, there is a lack of data on the slums in non-statutory towns as they are not reported, which further impedes planning. Srivastava (2017) notes that when it comes to assuring 'quality of life', which is central to urban planning, it cannot be set variedly for the different subsections of the population. To address this issue, one of the key barriers that need to be addressed is the creation of a detailed national database on the urban poor, not just in major cities but in smaller towns and regional centres. Such a database will help in minimising gaps in planning, increase access and coverage of services and ensuring ease in monitoring.

Kapur (2017) warns about the everlasting impact of the apartheid city of South Africa, the deep divisions created by it persists even after its abolishment more than two decades ago. He compares this with the gated communities of urban India as a raw pointer to divisions in social identities' that gets further weakened by poor urban planning. In addition to this segregated housing model, poor urban design, poor transport connections and lack of public squares will result in more substantial cities serving as smaller, unconnected and segmented towns under the umbrella of a name. The social transformation which is inherent to urbanisation should be careful about not deepening the existing social stratification in Indian society, but to minimise it. There are not many relevant studies on the level of mobile penetration among the urban poor in India. However, this sample data, though taken a few years earlier, indicates a very high level of penetration of mobile technology. Dharavi, with 550,000 population is one of the largest informal settlements in the world, is not just a residential space but a slum economy with around 1200 manufacturing units and 8000 shops. While surveying for their research in 2009, found that about 82 % of Dharavi's inhabitants had mobile phones, though only 26% of the population had toilets in their slum dwelling.

Hemani et al., (2012) writes that in the Indian context, social sustainability is often not holistic within the urban design and policy context. While social sustainability is context-dependent and the measuring it is difficult, the parameters that are set for policy, design and implementation of urban areas should not be just economically driven and in some cases with environmental mitigation aspects. In the context of the global north, planning policy and urban design theories are holistically embedded with concepts of sustainable urban form, compact city, new urbanism and smart growth. However, this is yet to become a prerogative in Indian planning, though some positive aspects are emerging from the SCM. It is still crucial that importance to social sustainability is regarded at the earliest as it will also pave the way for India to improve its current standing of 130 in the Human development index (PTI, 2018) among the world nations.

3.4.5 Public realm in Indian cities

The liveability quotient in any city relies on variables like public services, transport systems, economic opportunities, good governance, social quality and inclusivity, environmental quality and presence of social and cultural amenities. Fragmented functionalities which are a zero-sum game in existing Indian cities has led to unsightly developments, policy contradictions, civic apathy, disregarded public and open spaces, compromised health situation and increased stress levels. Several decades of neglect in urban transport network grid improvement with increased emphasis on mass transportation, improved road capacities and transport infrastructure investments have multiplied effects that have resulted in India being a choking nation (Jain, 2010)

Patil and Dongre (2014) highlight the lack of quality or its decline in the public realm of Indian cities. Encroachments in the public realm is a common occurrence in most Indian cities, which is most often as a result of street vendors, who comprise of the informal workforce. The informal sector comprises either self-employed workers or casual vendors, occupying the pavements/public/private premises, sometimes moving to different locations on pushcarts or carrying the wares in baskets, based on the demand for their wares. They unflaggingly test the market demand and move their business from one spot to another. Once the business gains momentum, more vendors with similar businesses form a cluster in that neighbourhood, which would draw in more people and thereby leading to more pedestrian traffic. As Whyte (1980) observes these vendors are primarily servicing a pre-existing demand that is not met by other existing establishments, but they get displaced by city authorities as they are regarded as illegal or unlicensed to perform their business activity. However, these anti-encroachment drives, and relocation programmes often fail as the encroachments often become an integral part of that space as they serve a function that has not been thought out.

3.4.6 Urban design – the least discussed discipline

The discipline of urban design acts as a medium between multiple disciplines related to engineering, architecture, environmental and transport planning. Several studies have indicated how design-led urban planning leads to economic developing and enhancing the social structure of cities (Carmona at al., 2001). Though countries like Singapore have adopted this smart densification approach, urban design in India, it is given the least importance. Urban design guidelines cannot be applied universally as each country has its onset of specific characteristics, like the geography of the place, cultural inclinations, historical significance, etc. (Hu and Chen, 2018).

Madanipour (1999) refers to the need for the regulatory push to boost the potential of good urban design, especially in some specific markets and locations, though in many other places the developers take the initiative themselves. By being an enabler of this enhancement potential of the public spaces, ‘the right to the city’ (Cuthbert, 2007) is established. Good ‘urban design’ not only improves the social aspects of the community without compromising the economic benefits. Urban design is considered as a ‘public or collective good’, one that is expended by many, with zero cost associated with additional customers (Nicholson, 2005). Gospodini (2002) further supports this view that in the past economic development directly contributed to the quality of the built environment; however, in recent years, the quality of the space attracts investment. At the same time, poor design outcome can impair the city both socially and as reduced returns for investments (CABE, 2006).

The last few decades have seen a transitional paradigm shift from the earlier energy efficient, vernacular and design approach towards net-positive energy buildings and currently undergoing a radical change in designing for environmental sustainability, in the case of developed countries. However, in the developing nations, the climate-responsive design is still a challenge due to high-density urban areas, population pressure, lack of finances, lack of political will and ignorance of the citizens (De and Mukherjee, 2014). The current day propensity, in Butler (2008) words “to design whatever the client wants, mostly based on cost or aesthetics”, is very much prevalent in the Indian design scene as well. The urban heat island effect in several Indian cities has gone up by several notches in the last few decades, causing the temperature to rise to 10 deg C (Sultana and Satyanarayana, 2018). However, there are no definitive planning and design guidelines in place to address this crucial issue.

The Delhi Urban Arts Commission (DUAC) was established in 1974 as an independent body created by an Act of the Parliament. This was soon after the establishment of Architect’s Act that was passed in the Parliament that gave legal recognition and established ethical obligations for the profession to be managed independently by the newly established the Council of Architecture. Bangalore followed Delhi in establishing its very own urban arts commission in 1976 (Scriver and Srivastava, 2015). The Act for the Urban Arts Commission gave it necessary authority to preserve the urban character of Delhi that had jurisdiction over planning, design and heritage related decisions. The Delhi commission was modelled after the Royal Fine Art Commission in the UK (Agrawal, 2010).

Art commissions are generally considered as a reviewing body that foresees the design approval of public art projects in urban areas. In addition to this, design review panels either at the national level or at a regional level are established to provide professional feedback and objective inputs to the local governments to upkeep a very high standard of design excellence. For instance, the Commission for Architecture and the Built Environment (CABE) in the United Kingdom and the Planning Unit in Sweden functions with this mandate at the national level. Likewise, the National Capital Commission in Ottawa in Canada and the Delhi Urban Arts Commission delivers the same agenda at the city level(Agrawal, 2010).

When it comes to place design, the lack of regulatory protocols mandating the need for following urban design procedures and techniques has resulted in the poor quality of spaces in Indian cities. Several practitioners and academics have called for the development of urban design as a public policy, with more robust public participation (Cuthbert, 2007; Madanipour, 1999). The lack of place-making approach in Indian cities has led to the unsatisfactory character of the public realm, bad pedestrian experience, increasingly high car dominance, increased congestion and pollution and poorly designed buildings with high energy consumption.

Marudachalam and Jothilakshmy (2010) highlight that the current planning rules are two-dimensional zoning plans and need to move towards performance-based guidelines. They advise that development plans should include – details on public spaces between buildings, integration of a new neighbourhood to its urban context, indicate movement pattern, locate street furniture, landscape, lighting, etc., and control relationship between built form and public realm. In India's context, the smart cities mission cannot be implemented without appropriate legislative measures at the city level, that could yield long-term strategic results towards good urban design. Therefore, it is necessary to look into the historical planning and design traditions in order to devise a framework for the future.

Chandigarh, the joint capital city for the states of Haryana and Punjab, was designed by Architect – planner Le Corbusier, post-independence in India. This city remains one of the best examples of city planning in independent India till this day. The design of the city-built form to open area ratio and included opens spaces, green belts, city parks and neighbourhood parks. This interrelation between its built form and nature and the clear hierarchy of green spaces ranging from neighbourhood to city level, it came to be regarded as the green city of India. The Chandigarh 2031 Master plan norms mandate the need for maintaining an area within the range of 10-12 sq. meter per person. Another feature of the city design, especially within the first phase is the establishment of long vistas looking into the skyline of the hills. This might include parks, playgrounds, amusement parks, maidans, botanical garden, traffic park, geological parks and other multi-purpose open areas. The norms also necessitated building low boundary walls that helped in the visual continuity of the green spaces (Chandigarh Administration, 2015).

3.5 The Arrival of the Smart Cities Mission

Jain (2010) calls Indian cities as an ‘amorphous manifestation of its socio-economic, cultural, political, and demographic diversity’ (pg. 108). Despite the rich civilisation and history, the inefficiency of the governance systems has led to defalcations in the infrastructure and amenities, thereby indirectly bolstering social inequity which has, in turn, resulted in the impairment of urban India (Nandi and Gamkhar, 2013). In this context, Hoelscher (2016) calls India’s attempt to transform from a rural to urban-based society as one of the most challenging demographic shift ever in human history. He presents a compelling argument on the agenda and policy behind the SCM that what a smart city is as set out by the government agenda and what it represents in practice, differs. This the author concludes, is not an isolated case with India, with different players following different means, but a global issue with not having a commonly agreed-upon definition as one of the reasons. He criticises that India’s smart city grand vision has been driven by elite, that has its focus on private wealth accumulation and a pro-urban growth based on technology. Datta (2015) sums up this intent as chasing the moolah and, in a sense, the market being the driving force resulting in the corporate sector seeing this as a way to accumulate wealth from the SCM.

The smart city rhetoric originally started with the election manifesto of building ‘100 new cities’ to address India’s infrastructure needs and delivering economic growth in urban areas. Thus, trying to set the tone for a revival from the economic stalemate of the previous government. However, the manifesto reshaped post winning the 2014 election and gave way to ‘100 smart cities. It has to be seen if this altered SCM initiative will still generate the same economic growth outcomes and meet infrastructure demands. Although the original intent publicised in 2014 for smart cities was to build 100 new Greenfield cities, the actual mission announcement during its launch primarily comprises of upgrading or regenerating existing cities to smart ones. The initial argument was centred on building new cities to cater to the growing population and increased migration to urban areas from rural centres. However, addressing the shortcomings of existing cities is the right priority before building new ones. After being promoted as one of the central proposals during the 2014 elections, the smart city vision mainly took shape following the appointment of the new government. In June

2015 the *Smart City Mission Transform-Nation* was launched in Delhi. The mission highlights that the comprehensive city planning development is a long-term process and therefore, cities to adapt the smart cities goal incrementally to achieve the vision finally. The goal of the current Smart Cities Mission (SCM) is to create cities with "smart physical, social, and institutional and economic infrastructure" This is proposed to be done vide tools like clean technology use, information and communication technology (ICT), private sector investments and public-private partnerships (PPP) funding model, enhanced citizen consultation and smart e-governance strategies for local bodies (ULB) (Ministry of Urban Development (MoUD), 2015).

Though the central government in 2014 was credited for initiating the smart city mission post their electoral victory in late 2013, the original outline and intent for the mission were identified much earlier. The 12th Five Year Plan (2012-2017) set out by the Planning Commission of India had a vision for smart cities that had inclusivity and sustainability as the core for urban growth in India. Chandrasekar et al., (2016), in their study, observed that India's smart mission had followed on the footpaths of China in announcing the SCM. However, China had initiated its move towards informatisation from early 2000 and invested heavily in its urban infrastructure, thereby paving for the current smart cities plan to be set up in 317 cities. India, on the other hand, has been slow to address its urban shortcomings and therefore, has completed the crucial groundwork before undertaking the smart city transformation. Shah et al., (2014) supports this argument when comparing the cities of Ahmedabad (India) and Shanghai (China) based on smart cities parameters set out by the Boyd Cohen Smart City Wheel tool and using Toronto (Canada) as the benchmark smart city. Using weighted averages for 27 shared parameters, they found that Ahmedabad scored 2.83 as against Shanghai's score of 4.08. Likewise, one such critic of smart cities, beyond its 'catchy definitions and terms' argue that it appraises a 'self-congratulatory tendency' (Hollands, 2008:3). As Thomas et al. (2016) demonstrate through their study, most participants were unfamiliar with the term smart city and found it abstract and obscure. Though the research was conducted in an advanced country like the UK in which such negative feedback was received, lessons need to be learned to encourage public participation and imparting smart city knowledge in India cannot be under emphasised. The one hundred cities SCM and the 500 cities Atal Mission for Rejuvenation and Urban Transformation (AMRUT) are missions that appear to have similar developmental goals. However, the main difference is that AMRUT undertakes a project-based approach in 500 cities and towns with a population of over 0.1 million, that aims to deliver essential services and amenities like water supply, sanitation, urban governance improvements and transport (PBI, 2015). The objective of SCM is "to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' solutions. The focus is on sustainable and inclusive development, and the idea is to look at compact areas, create a replicable model which would act as a lighthouse to other aspiring cities" (MoUD, 2015:5). In all, the policy document lists around 21 smart solutions (see Figure 3.9) listed under six categories as indicated in the figure below (Ministry of Urban Development (MoUD), 2015: p.6). The features for a comprehensive smart city promoted under the mission include the following eight characteristics

- Promoting mixed-use developments with compatible activities
- Housing opportunities for all and inclusiveness
- Walkable localities with the creation of cycling and pedestrian networks
- Developing open spaces and preserving existing ones
- Promoting multi-modal transport options
- Citizen-friendly governance that is also cost-effective
- Encouraging city identity
- Smart solutions to infrastructure
-

Figure 3. 100: Smart Solutions

Source: Ministry of Urban Development (MoUD), 2015

Bhattacharya et al., (2015) support that the SCM can be used as an opportunity to achieve larger goals that form part of the national development agenda, by addressing various urban challenges. Some of the critical areas identified for achieving this include

- Establishing an efficient urban management system – to address the absence of a panoptic monitoring and evaluation platform that tracks changes at the city level, utilises analytical platforms, and measure the performance of projects.
- Capacity building of Urban Institutions and Local Governments - to meet the increasingly high demand for technology-based domain requirements with a specific requirement to city building applications. There is a high potential for ULBs, through adequate training to step-up it is technology and skillset
- Achieving Decentralisation – by creating citizen engagement platforms for city-level projects implementation, by not only using technology but to also make institution-level changes in the decision-making process.
- Reducing conflicts - by establishing essential linkages between different project stages to prevent ad-hoc decision making, that leads to conflicts in urban spaces. A comprehensive decision -support platform could allow cities to be dealt with as a system of systems.
- We are creating enabling conditions for inclusive and equitable urbanisation – by addressing differences in income, opportunity, and quality of life by increasing access to infrastructure, facilities, and information.

Given the near permanence of huge policy decisions on the urban landscape, India's policymakers have the considerable opportunity to make the right decisions in the next 5-15 years, that would benefit the cities for many decades, if not for centuries to come. Global evidence suggests that poor planning leads to urban sprawl, which is, in turn, increases vehicle-dependency, thereby leading to substantial economic, environmental, and social costs. Contrastingly, compactly designed, well connected, and coordinated cities can be productive, resilient, cleaner, and safer. In India's case, though, density is never an issue, on the contrary, overcrowding is a significant issue, linked with poorly designed public services, lack of walking and cycling conditions and poor public transport. India does have the worst of both worlds and therefore, 'sprawl' in India could mean quite a different thing to that of its western counterparts (Tewari and Godfrey, 2016). Due to the immense land pressure because of overcrowding, sprawl, as witnessed in some cases, means the only way out for Indian cities to accommodate its burgeoning population that is ripping up the seams.

3.6 Conclusion

The SCM and the 500 cities proposals, aim to improve upon works carried out under other urban renewal schemes like Jawaharlal Nehru Urban Renewable Mission (JNNURM), initiated in 2005. Despite the decades-old presence of the JNNURM program, there has been no comprehensive evaluation of its achievements or its impacts. However, there have been several cases reflecting the lack of implementation capacities at the local government level. Therefore, at this crucial juncture, it will be costly for India to continue the journey of the unplanned, uncontrolled sprawled urban growth model, not just economically but even socially and environmentally. Although initially the government of India aimed to build one hundred new greenfield, the official announcement of the mission when it came through highlighted upgrading or retrofitting existing cities to smart ones. The initial argument was centred on building new cities to cater to the growing population and increased migration to urban areas from rural centres. However, probably due to the enormous funding requirements that would go into building one hundred new cities coupled with the infrastructure and deficits in existing cities, the sensible decision to address could have been made. Harris (2015) notes that this ‘smart city’ in India has not elicited the same kind of response from urban studies practitioners as with studies on North American, European and other East Asian smart cities. There are very few studies that have addressed this critical gap through the literature on global south’s smart cities, especially in India.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

Chapters two and three, by way of addressing the preliminary research questions, helped to gain an understanding of the research gap. As discussed, earl, the main objective of this research was to investigate the importance of place-based design in a smart city context and in particular, the need for urban design considerations. The introduction and literature review sections outlined the nature of the research problem and posed the lack of relevant studies on the role of urban design in smart cities as the key issue. This chapter discusses the research methods and the investigative process undertaken along with an overview of the research outlines process and strategies employed. The study adopted a qualitative approach with case studies as the primary research strategy. The research design focused on three key indicators, namely, '*What'* the research questions answers, *'How'* the evidence was gathered to answer the research questions and the methods used for '*Collecting'* the required information. To answer the research questions, this research used multiple methods to enable triangulation of the results and to validate the findings. The chapter consists of five sections, and the first section highlights the research gap derived from the literature review chapters; the second section discusses the philosophical and methodological issues in the choice of the methods and the justification for using a qualitative approach; the third section elaborates on the research design, and the fourth section briefly introduces the case studies and data collection methods; the fifth section discusses the research ethics and the final section summarises the key points from this chapter.

4.2 The Research Gap

Two main themes derived from the review of literature in the previous sections are discussed below

Theme -1: Limited research on smart cities in emerging economies

The consulting firm Frost and Sullivan (2018), estimate that the value of the smart city market will reach US$2 trillion in 2025, with almost 50 % of these costs covering cities in Europe and North American countries. The World Economic Forum in alliance with the G20 countries established the G20 Global Smart Cities Alliance on Technology Governance in 2019 to establish a policy on privacy, security and sustainability (Russo, 2019). The projection on the future smart city market, increasing co-operation on global policy development and the surge in smart cities research indicated in the literature review section, established that the smart city, as a city design approach, will further gain traction in the coming years. Traditionally, a handful of (mostly) western cities has been a source of comparison for most cities globally (Robinson, 2002). Likewise, urban transformation studies have primarily focussed on cities in the global north like London, New York and Tokyo or the established economies (Parnreiter, 2013). Even though cities in emerging economies requires in-depth research for improving development capabilities, smart city research appears to focus on cities from developed countries. Urban studies on the South East Asia region along with Latin American and African cities are limited and do not explore in-depth, the relationship between globalisation and its imprints on the respective cities. Although emerging economies or developing countries are still grappling with fulfilling the basic infrastructure needs in their cities, they are also affected by the everchanging global dynamics. Smart city initiatives in China and India need to be seen in this perspective, where these aspirational initiatives are aimed at future-proofing their cities.

While in advanced economies the governance structure and funding mechanism is well established, Glasmeier and Christopherson (2015) suggest that the success of the proposed technological innovations at the city level can only be truly measured in cities where there is less funding, and under established governance capabilities and infrastructure systems. Similarly, technological innovations developed for prosperous, established countries are outside the grasp of the urban population residing in most other countries of the world (Zegras et al. 2015). The authors cite the example of non-availability of an essential tool like a handheld transit map in Dhaka, the capital city of Bangladesh. Supporting this view is Harris (2015), who notes that the 'smart city' in India has not elicited the same kind of response from urban studies practitioners as on

North American, European and other East Asian smart cities. The paucity of research has resulted in shortcomings in empirical evidence, to wholly understand how the smart city model can contribute towards the development of cities in emerging economies. Therefore, the necessity for meaningful comparative work between cities fitting similar characteristics and nature is required to develop smart cities that are more diverse.

Theme -2: Need for a place-based approach in smart cities

The basic need of humans to belong somewhere and 'there is no reason to believe that this need will disappear as a result of increased electronic connectivity' (Mitchell, 1999, p. 73), drives the point that place centric design will always be relevant even if technological innovation is moving towards the forefront of city planning. Naderi (1999) identifies that a 'place' is a confluence of human behaviour, definitions and physical features. Spatial planning takes precedence over urban design, especially in emerging economies, where issues of unregulated land use often plague the cities. Without the integration of urban design, place-based planning will be incomplete. In a way, urban design fills the gap that has been left by other disciplines that have ignored the importance of public space, and have a restricted view on the built environment (Bentley, 1976; Jacobs and Appleyard, 1987; Madanipour, 2006) .

Moughtin et al. (1999) argue that an aesthetic approach is relevant in cities not just to overcome the social and economic issues, but to humanise the cities themselves, rendering them delightful experiences. Urban design within the art of city building is a set of methods used to organise and provide structure to the urban realm that is distinguishable from the design of private spaces. Though most cities tend to grow organically, a legible city with clear and distinct structure lends itself easily to the 'mind's eye' of its citizens and therefore results in a shared set of images that are easily recognisable as the city's image.

When fully integrated into the policy and planning systems, urban design can have a substantial effect on land use planning, infrastructure, built form and even the socio-demographic mix of a place (Australian Government, 2011). Given the several challenges facing cities in emerging economies, it is vital that "the earlier cities in developing countries take steps to future proof their urban development, the better.

There is a crucial window of opportunity for many cities to act at the earliest before getting engaged into unsustainable and unsuitable development pathways " (Atkins, 2014; p.ix). Therefore, an urban design integrated planning approach could help in future-proofing cities of the global south. 'Place' that is 'sensed' to monitor, control and improve outcomes for a better city, and that is also well-designed to evoke a sense of place, and belonging will deliver both a 'smart' and 'sensible' city. The conceptual model below (see Figure 4.1) illustrates the dominant role of smart cities as 'place of senses" and the need to integrate 'sense of place" into smart cities through urban design to achieve a holistic city model. The resultant city model will balance the high technology considerations in a smart city.

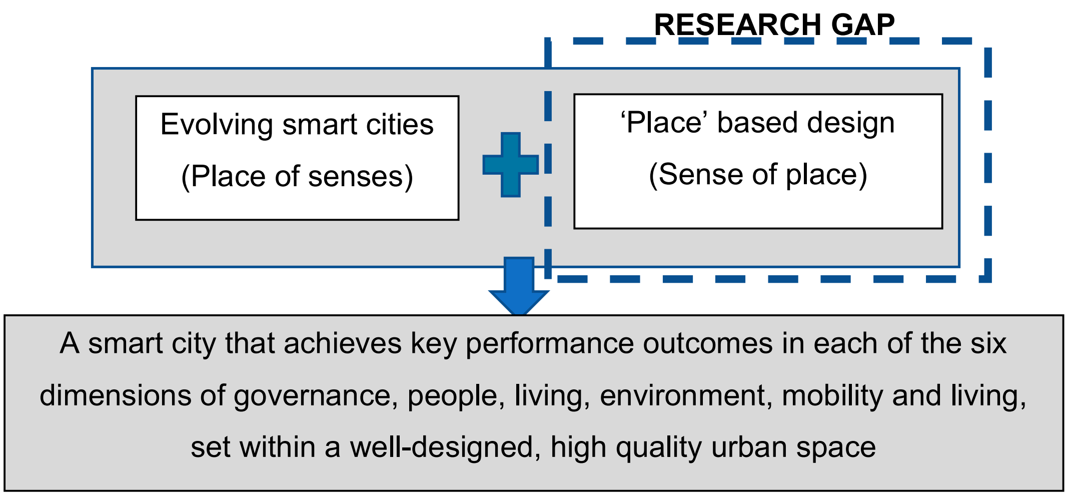

Figure 4. 1: Conceptual model for positioning urban design within a smart city
Source: Author's elaboration

The limits to research on the cities of the global south or emerging economies that are entering the smart city domain and the need for place centric design in smart cities are the two significant observations derived out of the literature review — these two inferences articulate the core premises for this research. Superficially, smart cities and place-based urban design appear to be two different dimensions altogether. However, this research attempts to underline the importance of the urban design perspective for smart cities, with a particular focus for Indian cities. This argument underlines that an urban design-based place focus is vital in a technology-oriented smart city and forms the hypothesis of this research. The philosophical and methodological framework for the research methods is explained in the next section.

4.3 Philosophical and Methodological underpinnings

From the time research was conducted for the first time, researchers always identified qualitative and quantitative methods as two distinct paradigms. Bryman (2001, p.48) states that the two approaches act as "lightning conductors to which sets of epistemological assumptions, theoretical approaches and methods are attracted", which appear incompatible. The use of a mixed-methods approach allows for combining these two paradigms and obtain answers to the problem of blending. However, Walter (2006) cautions that a mixed-method approach could potentially lead to conflicting results. Maruna and Maruna (2013) advise that devising a planning methodology is imbibed with complexity due to the constant changes that planning undergoes, and so needs careful consideration. A methodology that has adaptability built-in for constant improvement and renewal could assist in the advancement of new techniques in planning. Any approach to planning research should also be iterative and incremental in order to the whole process as a small unit of the significant and complex problem. In this way, it will be a constant progression towards development of the whole knowledge base in meeting the targeted objectives.

Compared to singularly qualitative or quantitative methods, a mixed-methods investigation provides a 'big picture' understanding of the research questions as it involves both qualitative and quantitative tools to improve the validity of the research. Especially in the field of social sciences, a monomethod approach is susceptible to its results as an error could impact the validity of the entire findings. Often confused with mixed- methods, multimethod research is a variation which involves applying two or more sources of data or methods to explore one or more research questions that are distinct yet highly linked to each other (Bryman, 2011). Creswell and Clark, (2007) also warn about the similarities between 'mixed-methods' and 'multi-method studies', which involve the collection of multiple types of qualitative or quantitative unlike 'mixed-methods studies that involve collecting both qualitative and quantitative data. The multiple methods used in multi-method research design each result in complete findings of their own to answer a sub-question of the research. The different results are then brought together and triangulated to form a comprehensive answer to address the research aim (Morse, 2003).

Given the nature of the current study that involves a qualitative research approach, this research is defined as "an inquiry process of understanding the social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting" (Creswell, 1994). Another more succinct definition by Creswell (2009, p.98) explains qualitative research as "exploratory, and researchers use it to explore a topic when the variables and theory base are unknown". However, from a positivistic methodology point of view, the use of qualitative methods in a multimethod setting is most often absent or misused. A qualitatively driven multi-method research offers flexibility to the researcher with each method used in the overall research, to address the research questions, maybe imparting an equal, adjunct or greater status. The qualitatively driven multimethod (see Figure 4.2) is generally proposed for a variety of reasons including to enhance the generalizability of the study and its findings, to improve the validity and reliability of the findings, to understand a phenomenon from different perspectives, or to develop a theoretical framework (Hesse-Biber,2015).

	Qualitatively Driven
Ontology: What is the nature of the reality?	Social reality is multiple.
Epistemology: What can we know and who can know?	Goal is to understand multiple subjectivities. Individuals are the "experts." Through intersubjectivity we understand human behaviors. There is no definitive subject–object split in knowledge-building.
Types of questions	The purpose of this research is to understand (the what, how, and why).
Type of data collected	Naturalistic settings: Participant observation (fieldwork) In-depth interviews Focus groups Unobtrusive data: Documents
Type of analysis	Inductive: Goal is to generate theory. Looks for general themes/patterns in the data. Uses "thick description." Compares and contrasts thematic data. Specific types of analyses examples: Grounded theory, narrative analysis
Goal	Understand a "process."

Figure 4. 2: Qualitatively driven approaches on research dimensions along the subjective-objective continuum

Source: Hesse-Biber et al. (2015)

In analysing and studying the nature and quality of urban spaces and arguing for an urban design approach to Indian smart cities, this research undertakes a qualitative approach to study the physical setting of the urban area. Likewise, the research involves qualitative analysis on the people perspective of the smart city proposals. The nature of this interpretive epistemology allows for understanding the physical world from the people perspective (Bryman, 2011) This research is based on the interpretive approach and is of the view that the hypothesis formulated will be best answered by using multiple methods based on the qualitative premises. As discussed in the previous sections, this research is concerned with exploring the impact of SCM on the urban design of Indian cities. Currently, the analysis of urban design with its subjective values is not well captured in the case of Indian cities and therefore requires in-depth exploration. Studies on the built environment have traditionally adopted a positivist approach while analysing urban form, or in general, the cityscape (Larice and Macdonald, 2013). Given that the positivist approach prescribes science to the truth, Batty (1980) criticises that this leads planners to use science for prediction and control, while not necessarily considering the human perspective. Therefore, this leads to a top-down approach in planning with planners assuming too much authority.

The urban design guideline can be formulated for smart cities only after carefully evaluating key considerations of urban design that will be relevant in a smart cities' context. Therefore, the research strategy calls for design-based action research that helps in understanding the current urban design scenarios in Indian cities. Action research is practice-based research that links the development and the evaluation stages into a cyclical process, so consequences of actions in term of success and failure are incorporated into the next round of action (Stringer, 1999). Bilandzic and Venable (2011) state that action research originally had two phases, namely, diagnostic and therapeutic, which was later extended to include a third stage, namely, the learning stage (see Figure 4.3).

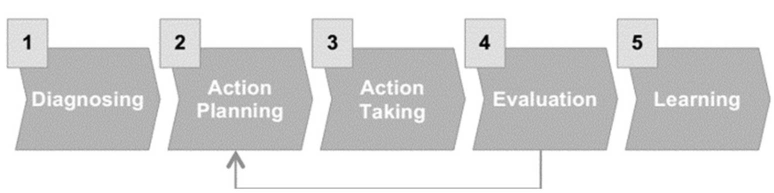

Figure 4. 3: Action research process model

Source: Susman and Evered (1978) and Bilandzic and Venable (2011)

Normative theories on urban design deal with the central question on the ways to create the best urban environment. Aesthetics is considered as a critical aspect in achieving this outcome (Steino, 2004). As de Jong and van der Voordt (2002) put it, descriptive research is a commonly used methodology in design-based research and is an effective method when the researcher's intent is to systematically give an in-depth analysis of the developments and their background. Descriptive case study research is very much a part of applied urban studies and provides a clearer and context-oriented view of the urban terrain in question. This research, therefore, aims to adopt a descriptive/interpretive epistemological standing, while it takes a qualitative approach towards the research design.

4.4 Research Design and Approach

According to Yin (2009, p. 26), the research design is the "logical sequence that connects the empirical data to a study's initial questions and ultimately to its conclusion". Based on the research paradigm, the research design determines the rational path of the research and therefore influences the choice of research methods. This research will examine the implications of the smart cities proposal on Indian cities and will focus on how urban design will change in its provision of public spaces. On the one hand, this requires analysing the current state of urban design in Indian cities and on the other hand it requires an assessment of urban design characteristics that should form part of the urban design framework to be analysed using qualitative methods. There has been limited research attempted thus far on this specific topic, and therefore it requires in-depth exploration. Within the framework of the case study strategy, the research will utilise multiple methods of data collection, consisting of a) interviews b) observations and c) secondary data sources. The broad research design outline highlighting the two separate stages of the design is indicated below (Figure 4.4).

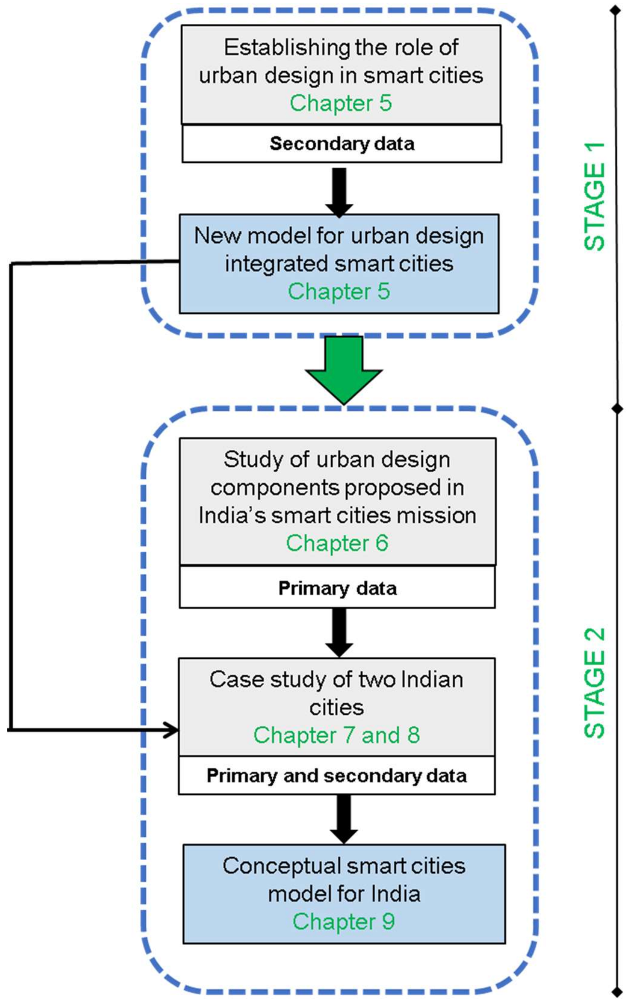

Figure 4.4: Research Process outline

The case study method is chosen as the research is focussed on identifying ways to improve the urban design of cities within the smart city's context. Within the framework of the case study, multiple methods will be employed for the collection of primary and secondary data consisting of field study, observations, interviews with key informants and secondary data sources. The thesis will apply a case study as the primary design strategy and will use the multiple-case design. Observation and recording of places and their activities is one qualitative method that fits within the descriptive case study research. Whyte and Spaces (2001) have carried out several research projects based on direct ethnographic field observations and recording as a methodology. Wang and Groat (2013) highlight that the main disadvantage of the case study method is the absence of a basis for generalisation of the findings. However, Yin (2009, p. 43) argues that the intent of case study research is not a generalisation of results from a small sample set to a large population, but to analytically generalise "a particular set of results to some broader theory". This research will test the findings of the case study against previously developed theories discussed in the literature review. Table 4.1 below indicates the research questions, strategies proposed and the expected outcomes.

Table 4. 1: Research questions, methods and the expected outcome

Research questions	Data collection method	Expected outcome
RQ.1. How does urban design contribute to the smart city model?	*Secondary data* Desk research	Establishes the role of urban design in contributing to the smart city model Proposes a new smart city model
RQ.2. What is the significance of urban design to India's smart cities mission?	*Primary data* Content analysis from SCM mission proposals	Gives contextual premises on the need for an urban design perspective in Indian smart cities
RQ.3. What are the barriers and opportunities that affect the implementation of smart cities in India?	*Primary and secondary data* Visual observations Semi-structured interview Desk research	Explores the smart indicators required to overcome the barriers in India's smart city proposals
RQ.4. What should be the components of the urban design framework for Indian cities?	*Primary and secondary data* Synthesis of findings from previous methods	Proposed conceptual smart city model for Indian cities

The research will be carried forward as a triangulation between the literature review, content analysis of the smart city proposals and data collection using key informant interviews, ethnographic observations and secondary sources as a means of testing the hypothesis. Smart cities are an evolving field of knowledge under the umbrella of urban planning and design. As indicated in figure 4.5, the research considers two phases to answer the primary research question. The first stage is the formulation of links between urban design and smart cities to establish urban design as the missing dimension in the smart cities model. The product of the first stage is the development of an enhanced smart city model with urban design as an integral part. The second stage again involves a two-step process, to first assess the importance of urban design and its potential contribution to the smart cities proposals in Indian cities. The second part of the second stage involves a case study of two Indian cities to establish the barriers and challenges in implementing smart cities in India. Based on the findings of the two-stage process, the findings are triangulated first to establish the importance of urban design discipline in a smart city and then the development of a conceptual smart city model for smart cities in India.

4.5 Case Study Approach in Urban studies

Historically, natural sciences and social sciences have locked horns over ideal research approach; the former is referred to as soft science due to its quantitative or experimental nature and the latter referred to as soft science due to its qualitative, interpretive or hermeneutic research platform. Case study researchers, especially in the field of social sciences, tend to work on a phenomenological premise as they use their perceptions during the investigative process (Mabry, 2008). The qualitative or interpretive basis also relies on the constructivist theory that all knowledge is personally constructed (Glassman, 2001; Phillips, 1995). The personal experience component provides the building blocks for constructing the knowledge base and articulating the interpretive research methodology. Due to the complex nature of the case study, adopting an interpretive methodology encourages the researcher to be alert in recognising patterns of activities and comprehend their meanings. This thesis will be an opportunity to connect case studies from India into the growing stream of studies on the quality of spaces in smart cities and will support the material available for similar international cities. The case study method adopted in the research works on three levels. At the first level, to establish the need for an urban design focus in smart Indian cities, an analysis of the proposals of twenty cities will be conducted.

Yin (1988, p.37) cautions that while adopting the case study approach and trying to generalise the findings to a broader setting, it is crucial not to leave out the particularities of that place. Several authors outline the need to have a methodology based on a clear theoretical framework (Yin, 2009; Lederman and Lederman, 2015). The urban design quality of a space may be measurable through such framework and can be termed as a ‘product framework’, as urban design becomes a tangible product in this approach (Zammit, 2014). On the other hand, Wang and Groat (2013) support the use of case studies as a research method to make use of the benefits of applying research techniques in a real-life setting. They refer to Jacobs' (1961) classic case study of New York’s urban spaces in her book *The Life and Death of Great American Cities* as it:

-examines the complex dynamics of a specific urban context

- uses different empirical methods to support an argument like participant observation, informal interview and documentary evidence

-builds upon the theory based on a case with explanatory power for application to a broader context

Campbell (2003) indicates that planning is an action-oriented field which, unlike others, might not possess the resources or power to conduct control experiments to verify test theories. Case study methods in planning are more illustrative and exploratory and therefore, cannot be easily replicated or generalised. One of the main challenges in planning is the lack of clarity between phenomenon and the context of case studies. For instance, if transportation is affected by land use, this, in turn, is influenced by other parameters like the local economy, environment, housing etc. In such a case where the difference between the parameters and the variables are loose, case studies are better strategies for analysis than statistics. Likewise, the practice orientation of planning also means that there is a constant evaluation of best and worst-case practice.

The case study as a research approach is the empirical investigation of a specified or bounded process (Smith, 1978), wherein the researcher selects a particular case or site due to the potential of the case to be informative about theory, a problem or a broader set of issues. The purpose that justifies the use of a case study is the result of a deep understanding of these phenomena. This acts as the guiding light for the researcher in all decisions taken in analysing the study. Decisions, including which site or sites will be more suitable, which questions will guide the investigation, which data collection methods are to be used, which participants will offer more information, which analyses will give significant answers and which reporting style will be more suited to the target audience. There is the possibility of taking too humble or too magnified a view of findings that can make the research go awry and therefore, careful planning of methodology is essential (Mabry, 2008).

The case study will form a significant part of data collection in this research, which will be preceded by a review of urban design proposals submitted by the twenty cities that were selected in the first round of the city challenge. The focus of the review will be on understanding the physical/morphological and socio-cultural attributes of the design interventions proposed. Based on this review, the need for an urban design perspective is established, and this is further tested using the case study scenario. The generic smart city model will act as a tool to guide the data collection and analysis during the case study phase. Within the case study, multiple methods of data collection consisting of content analysis, field visits, interviews and analysis of secondary sources were carried out. Refining the generic smart city model is the intent of the case study method, which represent the second phase of the research. The case study part of the research will involve looking in detail in the two cities of Chennai and Coimbatore, in the southern Indian state of Tamil Nadu. According to the central government classification of cities based on the cost of living (GOI, 2015), Chennai, a metropolitan city falls under Tier-I category, and Coimbatore is categorised as a Tier -II city. The analysis of these two cities that are different in terms of size and population is expected to render validity to the case study analysis.

4.5.1 Choosing the case study

Sarvimaeki (2013) claims that case studies as a research methodology have remained controversial and yet are widely deployed in various disciplines across the spectrum, including urban planning, design and architecture. The dispute is due to the method most times being loosely referred to as a term to mean a precedent study or sometimes as an alternative word for ‘example’. This practice contradicts the definition of case study research put forth by Yin (1988, p.23) as “an empirical enquiry that investigates a contemporary phenomenon within its real-life context; when boundaries between phenomenon and context are not evident; and in which multiple sources of evidence are used”. The method assists a researcher in conducting a detailed analysis of the data within a specific context. The uniqueness of the method lies in the detailed examination of a very small geographical area or number of subjects of interest. The approach, which observes either a phenomenon or an occurrence at the micro level, is directly in contrast to quantitative analysis which assesses patterns at a macro level.

Cases abound – identification of a case lies mostly within the purview of a researcher based on the case being informative enough, its worthiness as a study and practicality in gaining access to the study site (Mabry, 2008). Study of *typical cases* helps in understanding the existing state of affairs of a phenomenon by understanding and documenting patterns in ordinary events (Fine, 1991). *Atypical cases* can be informative, not just about the conditionalities of the phenomenon, but can also help in refining the associated theory. Therefore, the researcher should recognise the uniqueness of each case to appreciate its particularities and consider the negative, discrepant cases that may be dismissed by others as insignificant. Case study researchers understand that cases are shaped by many contexts like historical, social, political, philosophical, cultural, organisational, ideological, and so on. The relationships between the various contexts and the cases themselves are interdependent and reciprocal (Mabry, 2008). Punch (2008) advises that the researcher should carefully consider the sampling methods and in doing so should consider the size of the sample, organisations and individuals who would be involved. It is also essential to consider that the chosen samples could represent the broader population, so the collected data must be reliable and impartial.

Based on the above evidence, a variety of factors contributed to the selection of two case study cities of Chennai and Coimbatore. Firstly, the two cities were representative of two distinct city sizes, namely tier-I and tier-II cities, in the Indian context. Secondly, they were both selected in the first round of the smart cities challenge among the twenty cities, which coincided with the commencement of this research. Thirdly, both cities were in the same state, sharing a common language, which could be a logistical issue if the study was conducted in a different state. Almost every state in India has a local language, lack of familiarity with the language would impede the data collection process. As Tamil spoken in Tamil Nadu is the native language of the researcher, this helped in resolving the logistical issues. Nykiel (2007) states that judgement sampling is a non-probability method of sampling that has the researcher decide on the population cluster to gather data from sources. Likewise, convenience sampling defines the method by which the researcher decides the sampling population based on the ease with which the population can be contacted for feedback. The sampling method for this study was both judgmental and convenience based.

4.5.2 Interviews

Semi-structured and in-depth interviews were conducted during the field visit with a) local experts on urban planning and design b) SCM implementation officials c) city/district level urban development officials d) citizen groups e) practising planners/architects/urban designers and f) academics. The interviews focused on the expected impact on urban regeneration due to the smart cities' proposal and on site-specific issues in implementing the proposal. Also, the questions explored user-level expectations and how the use and meaning of the space will change in accordance with the area-based urban design interventions. This multiple method inquiry led to gathering evidence from multiple sources related to a specific research issue, thereby leading to triangulation (Wang and Groat, 2013) and minimising the threat to 'construct validity' of the research (Yin, 2009). The above methods provided ways of validating the conceptual smart city model from the human perspective (interviews), spatial perspective (field observation) and policy perspective (document analysis). The next section discusses the case study approach adopted in the research in detail, along with the choice of the case studies and sampling methods.

The preparatory work of this research involved a detailed literature review and analysis of Chennai and Coimbatore's broad planning policy, facilitating a better understanding of public space usage and historical context of public space in the two cities. Sixteen semi-structured interviews (see Appendix -H for interview questions) were conducted specifically with experts/officials/representatives involved in running the smart cities program in the two cities of Chennai and Coimbatore. The interviews focused on the following main issues: a) the impact of the smart cities proposal on the city's urban space in addressing the issues and b) the shortfalls of the proposal in dealing with the site-specific issues. Annexure - G shows the category the interviewees fall under along with their affiliation. The interviews were mostly open-ended, and the nature of the questions varied depending on the participants, though the general questions asked are summed up below. (see Appendix E & F) The interviews generally lasted for an average of one hour. All recordings of the interviews and the transcripts are stored securely under the Bond University data management system.

Stevens (2014) identifies that research questions concerning people’s behaviour in a public space could range from assessing the functionality of a specially built element like a street bench to establishing the necessity of the space itself and its users. Therefore, the best research that contributes to urban design knowledge is one that connects the ‘how’ and ‘why of public space with its use. Also, it is relevant not to view public space within the narrow confines of ‘functional’ and ‘productive’. Given the complex and perpetually changing nature of public spaces, any investigation needs to identify what approach would be useful and how it can be captured for further analysis. Note-taking and audio recording on-site offer valuable direct engagement, though the speed and detail of the recordings can be limited. The other most common method for recording participant observations is by recording using a still or video camera (Laurier and Philo, 2006). Contemporary equipment which captures and stores images in portable memory drives helps to capture a limitless number of photographs, that can be transferred to a computer and reviewed later. As the research revolves around the cities in India, the selected case studies should be a representative case of Indian cities at large along with their constraints. The selection of the case studies was based on a rather straightforward criterion that they should be representative of both large and medium to small scale cities that share the commonality of being developed under the umbrella of the SCM. The cities of Chennai and Coimbatore were an obvious choice for the case-study, given that they were among the twenty cities selected for implementing the SCM in the first round.

4.6 Research ethics

Interviews and expert discussions with various stakeholders were carried out as per the Bond University Human Research Ethics Committee (BUHRC) requirements. Confidentiality agreements were obtained from all participants in writing and participants were given the opportunity to opt-out of the study at any time, as per preference. In-depth interviews with human participants were involved only during the second phase of the research. Ethics clearance was obtained under the ethics clearance number - 0000016044 from BUHRC (see Appendix -D), before the commencement of fieldwork and interviews (Appendix-A). An explanatory statement explaining the research and code of conduct was furnished to all interview participants (Appendix-B). The document provided a brief description and identity of the study, identification of the researcher, information on the voluntary nature of participation and any time withdrawal, and assurance of confidentiality. Each participant was asked to sign a consent form (Appendix-C) before the commencement of the interview, and all interviews were recorded with consent from the participants for record-keeping and securely stored as per the University norms and ethics consent.

4.7 Conclusion

The chapter discussed the research methods followed in the study. The research undertook a multimethod approach using qualitative methods. that was interpretivist in nature and using a case study strategy. Within this framework of the methods, both primary and secondary data collection methods consisting of content analysis, interviews, observations and secondary sources, were employed in the research to address the research question. The next chapter confirms stage one phase of the research methods employed to establish the connections between smart cities and urban design.

CHAPTER 5

THE ROLE OF URBAN DESIGN IN A SMART CITY CONTEXT

5.1 Introduction

As illustrated in chapter four, the research process outlined (see Figure 4.4) in the research employs a two-stage approach. In the first stage, the role of urban design-in contributing to the smart city model is established. The missing dimension of 'place' within the smart city benchmarking tools was discussed briefly in section 2.6 and 2.7 of chapter 2, thereby providing the hypothesis on the need for good urban design in a technology oriented smart city. The chapter attempts to answer the research question one on the contribution of urban design to the smart city model. This chapter relies on secondary data extracted through desk research to answer the research questions. Considering that urban design and planning are both theory and practice-oriented disciplines, the chapter draws on both these premises to understand the contribution of urban design towards the smart city model.

5.2 Good design matters

Carmona (2010) identifies urban design as having six interrelated morphological, perpetual, social, visual, functional and temporal dimensions. Alessandro Aurigi in his foreword to the book by Zammit and Kenna (2016) on place-based design, argues that digital technology, or ICT, does not add an additional layer to Carmona's six dimensions, but rather that the ICT layer becomes interwoven with the existing layers, thereby increasing their complexity. While smart cities tend to evoke a tech-centric view, the shift towards a people-centric approach can be evoked only by putting the 'place' at the centre of the discussion.

In essence, urban design, as a profession, is an inter-disciplinary and collaborative field that involves an integrated approach between different players (Carmona, 2010). Due to its earlier origins from architecture (Mumford, 2009), architects staked a sole claim to this discipline for an extended period. Nevertheless, the discipline has expanded to include several professions including landscape architecture, civil engineering, transport planning, land use planning, real estate and public policy, environmental engineering and ecology (Larco, 2016). Good urban design leads to good governance (Madanipour, 2006) along with economic, social and environmental value for the residents (Carmona and Punter, 2013). The positive impact of urban design on urban spaces and its regeneration is well documented (Punter, 2007; Biddulph, 2011). It is also widely regarded that successful urban regeneration is design-led (Urban Task Force, 1999).

Bhattacharya et al., (2015) in their effort to analyse definitions of smart cities found that definitions that stem from a research perspective put forward sustainability as the primary goal for achievement, whereas the corporate sector's emphasis lies in promoting ICT to manage the city. Few definitions that have come out of the government sector emphasise ICT integration into governance along with the quality of life and environment. The above opinion correlates with table 2.1 and the discussions in section 2.5. Similarly, there is minimal specificity towards city form, urban design and overall functionality of smart cities in the analysed definitions. Min et al., (2019) in their analysis of smart city trends, find that only post-2016 has there been an increasing presence of the keyword sustainable urban planning in published literature. Before this period, it was viewed as two distinct components of city planning, with urban planning as the process and sustainability as a desired outcome resulting from a number of contributing factors. The above evidence shows a lack of clarity in balancing different aspects, and there is no co-ordination between the end and the means to achieve it, in this case, future-ready cities.

Cities around the globe have shifted their focus to deliver smart city proposals rather than achieving sustainability goals. However, these two are interconnected as smart cities share several universal principles with sustainable cities (Albino et al., 2015). Although we can draw parallels between these two city planning goals, there have been not many attempts to identify the crucial differences between these two paradigms. Ahvenniemi et al. (2017) try to address this gap by comparing the city assessment frameworks for both concepts. Sustainability assessment frameworks place more emphasis on measuring environmental sustainability, which smart city frameworks lack, as they focus more on social and economic outcomes. The authors also observe the gap in smart city frameworks and recommend devising a combined framework that concentrates not just on analysing the impact of smart solutions but on measuring the eventual goals of social, economic and environmental sustainability. Furthermore, Khan and Zaman (2018), in the analysis of various city labels, positions each of the eleven aspirational city labels like smart city, resilient city, eco-city and low carbon city, to rate them on various sustainability aspects. Though smart cities score high in technological aspects and reasonably well under environmental and social sustainability, their score for urban form varies from low to non-existent. The results accentuate the need for further research on the designing and planning of the built environment for future cities.

In order to achieve smart urban sustainability, decision-making in the planning process and citizen’s behaviour has to be effective, efficient and sustainable at its core. The citizen's attitude and lifestyle choices towards waste, travel and energy usage can be influenced in smart cities, therefore encouraging citizens towards sustainable behaviour (Khansari et al., 2014). Likewise, sustainable planning can be ensured through urban infrastructure changes regarding transport, energy and land-use and in the urban governance structure (see Fig 5.1). Therefore, the need arises to combine the benefits of sustainable into the smart cities model, which also focuses on delivering good planning and design outcomes in cities.

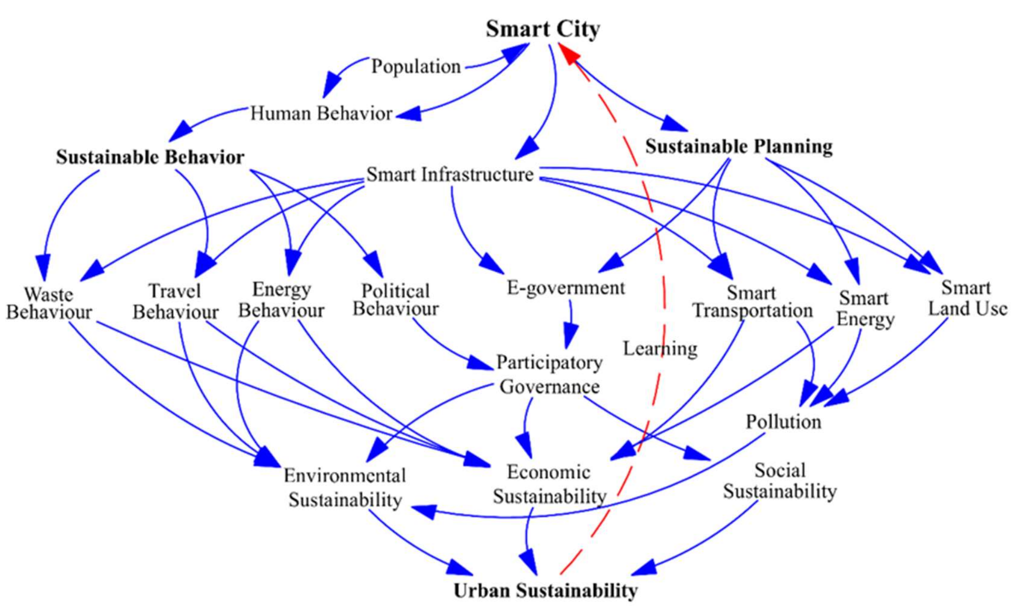

Figure 5. 1: Process of achieving ***urban sustainability with smart cities***

Source: Khansari et al. (2014)

Urban design traditionally was considered to have an ornamental and decorative role (Moughtin et al., 1999) or to be an additional overlay in the city building process. Marshall and Caliskan (2011) illustrate the term ‘urban design’ in the general sense as a ‘preconception of something before it is built’. In a broad sense, urban design is a way of shaping the form of the physical urban fabric, organising urban structure, directing the interrelation between different elements and creating coherent assemblages of buildings and spaces. The various definitions of urban design put forth by different authors include the following:

> “ urban design lies between the broad-brush abstraction of planning and concrete specificities of architecture” (Buchanan,n.d.; cited in Cowan, 2005; p. 416)
>
> “a placemaking process that involves creating three-dimensional urban dorms and space, which enhance the experience of towns and cities” (Wall and Waterman, 2010; p. 17)
>
> ”urban design, in a specific sense, grew out of an effort to combine art and science in the three-dimensional planning of urban environments”.(Mumford 2009, p. 8).
>
> “ the theory and practice of producing the form and life of the city in the macro, meso and micro scales, designing and making, more extensively guiding the design and making of the city and its parts’ (Günay, 1999; p.32).

A well-formulated urban design guideline should not only result in coherent and continuous urban form development but needs to achieve a balance that is not just prescriptive, but one that also encourages the natural ebb and flow of development cycles. Though planning controls and codes limit the problems of incongruity in urban spaces, over-prescription of design codes will prove detrimental to the innovation of new ideas. (Sanders, 2013). There are also concerns that architects and urban designers, by not utilising data from a broad range of sources, limit the employment of an evidence-based approach for design proposals. As a result of these situations, a design project that promotes improving urban quality is often overlooked for an urban infrastructure project that is backed by qualitative data and therefore, more eagerly accepted by policymakers. Efforts should thus be made to bring practice closer to research.

Urban design is highly subjective, and this creates an ambiguous setting that contributes to the indefinite position it occupies among built environment disciplines. Franck and Stevens (2006) refer to the ‘looseness’ factor in the design of public space as an essential indicator of the quality of the space, as it allows a variety of unexpected appropriations and uses of the space in addition to the planned uses. Unplanned, irrational and sometimes impractical activities contribute to the richness of experiences in each space. One primary critique of the urban design process is that practitioners tend to obsess over the finished product rather than viewing it as “an on-going long-term process intertwined with social and political mechanisms” (Inam, 2002, p.37) According to Carmona (2014a), the obsession in the developed world (especially in the US) is to bundle up preferred urban forms with a sprinkling of social/ecological content together with philosophical meaning, and then deliver in the name of the latest ‘isms’ like post urbanism, new urbanism, ecological urbanism and tactical urbanism. In contrast, in the UK the reviewing of high-profile projects by press occurs before completion and without debate during the development process, leading to judgments being made purely on an image-centric basis, without understanding the design, political and development pressures that shaped it (Carmona and Wunderlich, 2012, p.5). To overcome this prevalent perplexity in understanding what contributes to well-designed public spaces, it is helpful to devise frameworks or guidelines with a set of principles.

Larco's (2016) attempts to formulate a set of frameworks for sustainable urban design in cities, which he describes as a work in progress, could be considered as a good starting point for devising an urban design guideline for smart cities. Larco created a matrix that had sustainability foci on one axis and geographical scale, namely region, neighbourhood/district, block, street and parcel, on the other axis. Within this framework, he lays out how different urban design elements, including street design, public realm, transit network arrangement, pedestrian and bicycle infrastructure, housing typologies and urban vegetation ecosystem, are fitted in to meet the sustainability criteria. However, Wheeler (2016) points out, in his criticism of Larco’s work, that although having a checklist of priorities is useful for urban designers, yet the priorities may not be universally applicable as the framework is heavily rooted in ‘place’. The variations in the findings raise the need for a guideline that not only meets sustainability goals and metrics but one that is based on an understanding of the local ‘geographic, temporal, social, cultural, economic, political, institutional and environmental context’ (Wheeler, 2016, p.48).

An urban design framework (UDF) is used as a “ map of the city that illustrates the direction and future aspirations for the city’s physical environment, identifying areas of change and future connections, along with major built, natural and cultural features” (City of Portland, n.d., p.1). The City of Portland’s UDF includes four significant ideas, namely, centres that focus on growth and change; connections-linking a whole city; and natural features and pattern areas recognizing the one size does not fit all approach. After reviewing the problems associated with modern urban design, Jacobs and Appleyard (1987) in their paper, ‘Towards an Urban Design Manifesto’, proposes the seven goals for an excellent urban environment :

1.Liveability – an urban environment should be a place for everyone, as their sanctuary, which is relatively free of intrusions.

2.Identity and control – the citizens should be able to associate at least some part of the environment to themselves, which forms part of their identity or a place where they belong. The urban environment should encourage everyone to get involved, participate and express themselves.

3.Access to opportunities, imagination and joy – the city should be a place that helps breakdown the traditional barriers., a place of excitement that extends their experience and encourages them to have fun.

4.Authenticity and meaning

5.Community and public life

6.Urban self-reliance

7.An environment for all

International research has consistently emphasised that the liveability of a place is considerably increased owing to good urban design and architecture. The critical components of enhancing liveability include improved safety and security, enhanced community participation, walkable spaces, and fostering cultural identity and community pride. Such well-designed places thus become the centre of the community leading the social and economic activities (OVGA, 2017). The public realm does not as is sometimes misunderstood, comprises the public buildings, and public spaces like streets, squares, parks, but is also determined by the form and composition of the private spaces that determine the overall urban character of that place.

Privately-owned buildings and land still have an equally pronounced impact, not just through their appearance, but through shading effects and increasing or decreasing wind severity due to their siting and spacing. The appreciation or criticism by the public of all spaces, including private spaces, forms the ethical basis for statutory planning, thereby limiting the decision-making capabilities of the private sector in the development of such spaces and structures. The devolution of a framework that enhances the quality of public places and their urban character is a significant area of concern in the field of planning and urban design (Dovey, 1999). Jan Gehl is a strong advocate of places being people-centric, where active public spaces prioritise walking and cycling over cars. Four key characteristics advocated by Gehl to achieve such spaces are planning for mixed-use, human scale, diversity, and affordability (Gehl Architects, 2010). Numerous theories on good urban design characteristics have been sufficiently explored, yet as Alizadeh (2009) points out, there has been no review on the urban design's role in the post-digital era. There has been no review on the urban design theories that comprehensively investigates the social changes after the digital revolution. Even though the thesis does not intend to develop urban design theories, it is important to note the key point by Alizadeh (2009) on the need for review on urban design in changing scenarios. Smart cities, as one such post-digital city model, does not sufficiently represent the place dimension as a contributing characteristic of the model, as highlighted in chapter two. This next section, therefore, explores the significant contributions through urban design towards the smart city form.

5.3 Urban Design and Smart Cities – The Common Ground

Having established the importance of urban planning and design in a smart city, this section highlights how urban design contributes to the six dimensions of a smart city. There have been some studies on the impact of ICT on urban design (Ghorbani et al.,

2013) while others (Weingart et al., 2006) have considered ICT and sustainability in smart cities management. Technology- centric urban development has been driving city planning for a while, with the use of video surveillance and other sensing techniques. Despite its very short existence as a city model, various cities around the globe have embraced the smart cities concept, and this includes not just the developed countries but several countries of the global south, including India, China and South Africa. Yigitcanlar (2016), presents a detailed overview of the smart city practices adopted by cities in various continents. Reviewing the available literature reveals that cities around the world are experimenting with different aspects of technology. Moving into the twenty-first century, smart cities strategies are recognized as long-term future growth directions by many cities around the globe like London, Helsinki, Melbourne, Brisbane, Vienna, Stockholm, and Paris. Most of the above cities are from developed economies with pre-existing good quality infrastructure, high urban spaces and city services, achieved through efficient planning and design approach. Therefore, technology as an add on improves efficiency levels and living conditions. Contrastingly in emerging economies like India, the underlying infrastructure layer itself is incomplete.

While the evolution of smart cities is unclear, the versatility of the city model was discussed earlier (see Chapter 2). Despite the versatility, a core principle, namely the place-based approach enabled through urban planning, and design practices are found missing. Urban design as a distinct profession was only established in 1956, during the international conference on the future of cities held at Harvard Graduate School of Design. The 1960s saw the primary role of the profession as contributing to the beautification of cities. The need for the professional rose as a result of modern architecture's role limited to individual building designs and urban planning being concerned only with the policy frameworks for land use (Dias et al., 2018). Urban design is seen as bridging this gap between architecture and urban planning. One of the first attempts to establish the value of urban design was by the, then Commission for Architecture and the Built Environment (CABE) in the United Kingdom (merged with the Design Council in 2011), which published the document "The Value of Urban Design" in 2001 (Carmona et al., 2001). The Ministry for the Environment (2005) of New Zealand published a similar document highlighting the values of good urban design. These two documents are some of the earliest attempts to set out nation-wide urban design guidance. The documents indicate that the discipline presents wide-ranging benefits that are economic, environmental, social or cultural, and are both tangible and intangible. The primary benefactors of good urban design include the investors, developers, designers, occupiers, everyday users and society as a whole, as well as the public authorities. While some benefits of well-designed urban spaces can be perceived, it is challenging to measure the quality wholly due to the existence of several spill over benefits which are directly unquantifiable.

As highlighted in chapter two, the smart city indicators listed by several researchers do not include urban design as a distinct contributor to a smart city. However, having already established the need for good urban design in a smart city, the following section looks at ways urban design is found to contribute to each of the six smart city characteristics. This section attempts to make these crucial connections between urban design and the eighteen indicators listed in Cohen's smart cities wheel (see Figure 2.10). The key benefits of this desk research are then presented at the end of each sub-section and are then cumulated and presented as a table in section 5.4

5.3.1 Urban design and Smart Economy

The contribution towards the economic growth of an urban area can be attributed to numerous reasons and yet enumerating the value of urban design on the economy is challenging. Post-initiation of the digital era, research indicates the direct influence of ICT infrastructure on economic growth (Röller and Waverman, 2001). Furthermore, cities that have achieved the most rapid growth rate are the ones that have an educated labour force. The relationship between human capital and urban development in which there is a need for the skilled labour force to produce the innovative products created by entrepreneurs (Berry and Glaeser 2005), is beneficial to improve the overall standing of a city. Other attributes, such as availability of high-quality infrastructure, well-connected transportation networks, local and global connectivity, also contribute to economic growth in cities. In contrast, it is challenging to quantify urban design along with the same terms. Nonetheless, Nase, Berry, and Adair (2015) state that there is a growing body of literature that establishes the economic benefits of good urban design. One such study is Nicholson and Snyder's (2008) on the economic theory that the value of specific components like urban design, classified as public goods, is all-inclusive as the advantage of the cost increase for an additional user is zero. Therefore, to understand the contribution of urban design towards economic development, this attribute needs analysis, as discussed below.

Entrepreneurship and innovation

An enhanced built environment plays a central role in promoting the economic and urban revival of a city. Often, design professionals view design and architecture as detached elements from the social and economic context of the cities. Hubbard (1995) recognises that the 1980s were the period that brought about increased public awareness towards architectural and design issues in the United Kingdom. Following its decline as an industrial city, Birmingham underwent a significant revitalisation of the urban environment. Using a combination of traditional instruments like development control rules and creating new distinctive landscapes, the post-modernist attempts to shape the image of the city contributed to making the city an attractive entrepreneurial destination, with a suitable business environment and an improved competitive advantage.

The Birmingham Urban Design Study (1990) document created by Francis Tibbalds presented a comprehensive urban design study of the city centre that offered future vision and strategic guidelines for a transformation within 30 years. It was the first study of this nature at that time in England. Some of the critical aspects of the document emphasised that the city should improve legibility, increasing accessibility, promoting street-level activity and formulating site-specific guidelines for landmark projects. As a result, through these improved urban design initiatives, the city made a vital transformation into a conducive environment for businesses and investments. A summary of the different urban design attributes that emerged from the above discussion is tabulated below:

Index	*Indicators*
B1.1	Image of the city promotes investment
B1.2	Legibility, Accessibility and street-level activity encourage business

Productivity

Measuring benefits in terms of monetary value or market prices in the field of urban planning and design is difficult. As these disciplines are considered as public goods, the cost value has to be qualitatively measured, which is challenging. Productivity gains achieved through working in high-quality urban spaces and well-designed workplaces is another aspect that is often undervalued. Its benefits are one of the many externalities, and therefore, their price or cost is estimated much lower. However, well designed built environments positively impact the productivity of employees; health and well-being and the overall satisfaction of the workforce (Carmona et al., 2001). Likewise, the links between density and increased productivity are also a well-established factor, especially in metropolitan regions, this productivity advantage is significantly higher. These areas have a higher concentration of knowledge workers and also attract educated and skilled workers from all over the region. Besides, walkable areas contribute to increased retail revenue and improved commercial absorption rates providing enormous economic benefits.

Companies achieve higher productivity benefits when they are located centrally in compact, walkable neighbourhoods that have multi-modal access. The central location will provide greater access to current and future employees who may arrive from all over the region. The access to different commuting options also adds to less absenteeism, improves physical activity and, thereby improves health benefits (United States Environmental Protection Agency (EPA), 2013). For instance, the waterfront precinct development in Brisbane's Eagle Street (see Figure 5.2) is proposing to improve on the existing leisure facilities within the business district. The revitalised precinct, with improved riverfront access through ferry, river walk and enhanced public space, aims to create more lifestyle choices and amenities both to the CBD workers and city dwellers (Dexus, 2019). Thus, the precinct will provide improved opportunities for workers enhancing productivity.

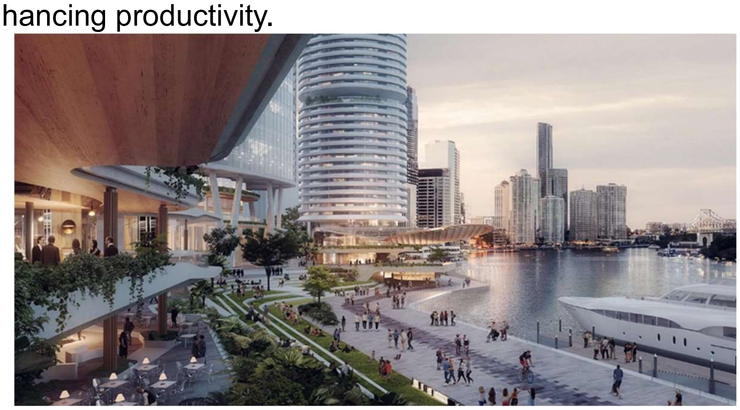

Figure 5. 2: Proposed revitalization of Eagle Street Pier, Brisbane

Source: Dexus (2019)

Index	Indicators
B1.3	High-quality public realm promotes productivity
B1.4	Compact, walkable neighbourhoods reduce absenteeism and boost productivity

Local and Global Interconnectedness

The economic benefits of local and global interconnectedness achieved through urban planning and design are challenging to demonstrate. However, there are a few rare cases where these benefits can be tangibly demonstrated. The Guggenheim Museum in Bilbao, Spain, built-in 1997, created the renowned 'Bilboa effect' by reviving the economically distressed city of Bilbao and pushing it to the sphere of international popularity. Designed by architect Frank O' Gehry, the building was instrumental in the urban and economic regeneration of the city and the region. Plaza and Haarich (2015) in their research, discuss the phenomenon driven by the brand- Guggenheim Museum in strengthening the global linkages to the local area and regions of Spain. The urban rejuvenation project within the Abandoibarra Master plan area ensured economic integration by acting as an anchor for tourism and caused economic impact to local companies and regional institutions. The museum was also played a big role in bringing global visibility and networking opportunities to the Bilbao region. Though such cultural projects with global level economic impacts are rare, The Guggenheim Museum demonstrates the impetus that can be provided by well-designed urban projects to the local and regional economy.

Index	Indicators
B1.5	High-quality urban places stimulate the local and regional economy

5.3.2 Urban Design and Smart Environment

Several studies have used ICT driven technology to understand the environmental benefits of city planning. The MIT City Science research group focuses on using technology to understand human activity, environmental conditions and market dynamics to devise strategies that would influence people to adopt sustainable behaviour patterns. The City Matrix project, under the broad umbrella of its various research, utilises real-time, data-driven urban simulation and artificial intelligence for decision making and community engagement within the sphere of urban design and urban planning. The platform explores machine learning tools (see Figure 5.3) that would assist in shifting the current nature of the top-down urban planning approach, which is highly reliant on a subjective decision, towards open-ended decision-making suggestions, based on quantifiable data and performance. Due to the low-cost, fast, intuitive and accurate simulations using the various algorithms, it is easy to devise numerous permutations for possible solutions that can help in making evidence-based urban decisions (Zhang et al., 2018). Thus, the use of technology within the domain of urban planning and practice, which also contributes to environmental sustainability, is theoretically established.

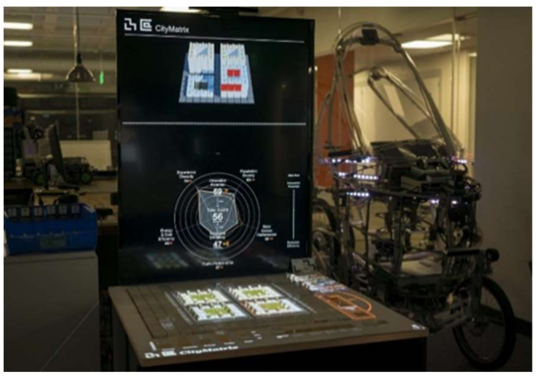

Figure 5. 3: Urban simulation and artificial intelligence in city planning

Source: Zhang (2017)

The contribution of urban design towards promoting a smart environment in a smart city is ascertained in a few ways. Though the environmental impacts of urban design are theoretically well established, it requires more significant adaptation in practice (Carmona, 2009). This is because the urban design approach often regards meeting human social needs as more important than preserving the natural environment. Designers and architects also focus on individual project needs of their clients and most times do not consider the benefits to the broader community (Lang,1994). However, in a smart city, this attribute needs far higher levels of understanding and implementation to garner positive outcomes. How these beneficial interlinkages happen is discussed below.

Green buildings

Kim (2017), mentions that it is essential to give due consideration to energy-efficient design at both the building and the city level in urban planning and mandate policy on energy conservation as part of urban design and planning disciplines. Kanters and Wall (2014) also support this view that urban planners sometimes are not aware of the full impact of their design decisions on planning for energy-efficient buildings. As the majority of future buildings will be built in cities to accommodate increasing urbanisation, it is essential to consider energy aspects in the urban design process (Figure 5.4) of the city planning.

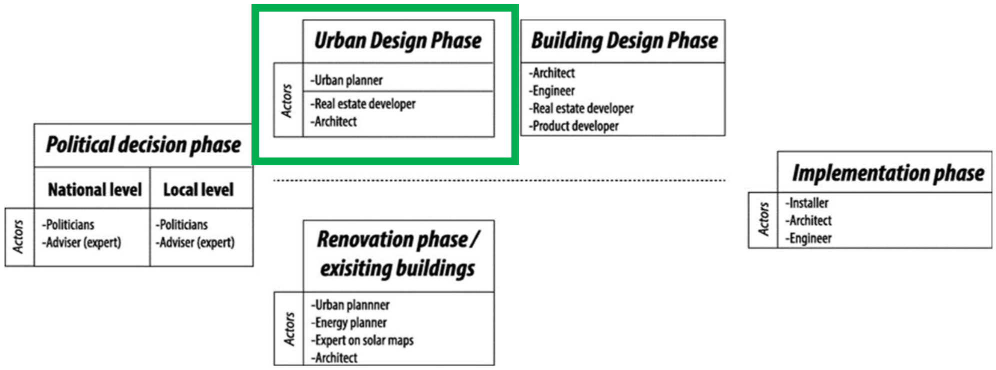

Figure 5. 4: Overview of different phases in the urban planning process

Source: Kanters and Wall (2014)

The green buildings concept is one of the central ideas of sustainability in cities. The idea is to develop buildings that reduce the utilisation of natural resources, protect the environment and at the same time, deliver quality spaces to its users. Green building rating systems have been developed worldwide to measure the sustainability of buildings such as LEED (USA), BREEAM (UK), Greenstar (Australia) and GRIHA (India) to name a few (Ferwati et al., 2019). Though most of these rating systems began with setting rating criteria for individual buildings or project sites, they have now evolved to include the broader large-scale developments like Master-planned communities and newly established neighbourhoods. The Green Star Communities rating system in Australia includes several credit factors that relate to urban design such as culture, heritage and identity, walkable access to amenities, safe places and sustainable transport and movement (Green Building Council Australia, 2015). Although green buildings are considered a product of architecture; urban planning and design provide the setting for a wholesome 'green' attribute to the building and its surroundings in a smart city.

Index	Indicators
B2.1	Energy integrated planning and design reduces energy demands
B2.2	Green rating systems for public places encourage sustainable practices

Green energy

Green energy refers to energy obtained from renewable sources and is typically derived from solar, wind, biomass and hydro sources. While on the one hand, continually invest in renewable sources is essential for both sustainable and climate resilience, it is also equally important to conserve energy usage through sensitive design. Kim (2017) states there is currently no standardised practice for energy-integrated planning and design. At the building level, energy savings can be achieved by following passive design principles to gain maximum thermal comfort with less heating and cooling cost. The urban form includes the broad parameters of building density, land use mix, transportation routes and patterns, which has a considerable impact on energy usage in cities. A case study on the city of Gwacheon near Soul, South Korea revealed that with simple alternative design solutions like changes to the street pattern, orientation and spacing of the buildings, up to 30 % of energy consumption could be minimised. Therefore, at the city level, several design considerations such as below are essential to achieve energy-conserving cities, as can be seen below:

- Residential densities near central business districts
- The layout of streets – for instance, curvilinear layouts have shorter utility lines and loads
- Building orientation and setback between buildings
- Landscape planting for urban cooling and reduced urban heat island effect

There have also been a few studies that have demonstrated the use of technology in predicting energy demands and ways to reduce these demands through different urban design strategies. For instance, Yamagata and Seya (2013) in their paper, discusses the concept of creating a simulation model for the Tokyo metropolitan region, the largest megacity in the world, for understanding the land-use planning. They calibrated the model using existing statistical data and thereby simulated two alternative urban scenarios for the year 2050. These scenarios were used to generate possible future dispersion or compactness of the city to devise urban strategies for the future. The same model has been used to calculate energy demand and supply data assuming solar energy-based generation models. They found that compact urban form results in reduced energy demand, whereas detached suburbs helped in increasing solar energy outputs. The study was useful in demonstrating the role of technology in forecasting future city scenarios for planning and likewise established that well designed compact urban forms reduce resource intensiveness in cities.

Index	Indicators
B2.1	Energy integrated planning and design reduces energy demands *[2]
B2.3	Compact urban forms reduce energy demands and pollution

Green urban planning

Margolin (2015) looked at ways in which urban design can contribute towards sustainable planning practice. Designers are responsible for creating various structures, systems and environments and therefore very much contribute to the human environment, which is a subsection of the ecological environment. The current nature of design is changing in nature, owing to new challenges and inherent design thinking would enable designers to imagine new possibilities to overcome some of the problematic issues. In the case of Curitiba, Brazil, for instance, the establishment of an Institute for Research in Urban Planning ensured the delivery of several positive outcomes including an efficient transportation system with buses at the centre, innovative bus shelters, and recycling of plastic containers into market stall structures and toys for children. Several other relatively well-designed small initiatives like growing food in urban parks, portable food markets and modified bicycle carts for transporting composts, help in this objective and create jobs. Such initiatives, though small, can contribute immensely towards sustainable practices in a smart city.

Index	Indicators
B2.4	Design thinking in planning improves sustainable practices

5.3.3 Urban Design and Living

Establishing direct causal effects between the design of the physical environment and quality of urban life is challenging. One of the main challenges lies in specifying the meaning of "quality of urban life" (Proshansky and Fabian, 2013). Urban quality of life is a multi-dimensional concept and is a result of the relationship between various

[2] *This is a common benefit of green buildings and green energy categories*

dimensions such as environmental, political, physical, social, mobility, economic and psychological (Serag El-Din et al., 2013). Although urban design directly contributes only to the physical dimension, in a smart city, this will have far-reaching effects on other dimensions such as psychological, economic and social as discussed below.

Healthy

Several studies over the last two decades have researched the relationship between the built environment and health benefits. Some longitudinal studies have tried to establish direct causation between how the environment positively affects people's behaviour regarding encouraging physical activity. Lee and Maheswaran (2011) conducted a study on available research interlinking availability and accessibility to green spaces having a positive health impact. Though they felt that conclusive links could not be established between physical and mental health and well-being in relation to urban green spaces, they reported that the majority of the findings indicated that urban design could facilitate physical activity. Likewise, other external determinants like the perception of safety, the attractiveness of the public space and lack of pollution (both air and noise) contributed to this overall effect favourably.

Accessibility of green spaces and open areas, pollution-free areas, less traffic noise and clean surroundings are all significant contributors to overall wellbeing. Carmona (2019a) identifies the health outcomes due to the physical environment as one of the contributors to 'place value' instead of 'place quality'. Several health benefits associated with quality of places were identified in the study, such as better physical health, better mental health due to reduced stress and depression, improved general fitness due to increased walking and exercise, greater daily comfort and an enhanced quality of life.

Index	*Indicators*
B3.1	Well-designed green spaces promote physical and mental well-being

Safe

Urban safety is widely recognised as a crucial element of urban sustainability and in creating 'secure societies', crime prevention is no longer seen as the domain of crime policy but a part of public policy that covers social and urban planning (Chiodi, 2016). While smart cities can rely on surveillance technology for enhanced safety in streets and public spaces, technology cannot aid in crime prevention. However, internationally practised agendas such as crime prevention through environmental design (CPTED) makes crime prevention a much more realistic and achievable target. The Victorian state government in Australia (State of Victoria, 2019) advocates the following urban design principles for safer use of public spaces by the community:

- visibility and natural surveillance – visibility of activities prevent potential offenders from taking action
- access, movement and sightlines – clear, visible access and well-defined routes minimise the occurrence of crime
- activity – activating the use of public spaces increases social interaction in the community, increases visibility and ensures human surveillance to reduce risk of crime
- ownership – places that evoke a sense of ownership among community alleviate crime
- maintenance – well maintained and managed public spaces create a generally safer feel that improves its usage and thereby natural surveillance

Crime Prevention through urban design and planning strategies is a widely accepted practice in several countries in Europe. However, these strategies are based on the premise of 'eyes on the street' which is dependent on factors like knowing the place attachment, place identity and sense of community of the inhabitants (Manzo and Perkins, 2006). These factors influence the quality of 'eyes on the street', and therefore sometimes the effectiveness is not always achieved. In this scenario, Chiodi (2016) emphasises the nexus of crime prevention through urban design strategies such as 'active frontages' for natural surveillance along with the use of smart technology that could significantly enhance crime prevention capabilities of urban space. The city of Anyang in South Korea has a centralised command centre, which, in addition to monitoring traffic and weather disaster management, uses technology to monitor and prevent potential crime (Figure 5.5).

Figure 5. 5: Pattern analysis of suspect vehicle in Anyang, Republic of Korea

Source: Lee, Kwon, Cho, Kim, and Lee (2016)

Index	*Indicators*
B3.2	Crime prevention through urban design minimises the incidence of crime

Culturally vibrant and happiness

The paper 'Agenda 21 for Culture' (Duxbury et al., 2016) argues that the cultural dimension in the urban development process is undervalued. Culturally sensitive urban development can enhance the participatory mechanism in local governments and is often viewed as the fourth pillar of sustainable development. Vibrant cities are most often the outcome of public spaces which are not too formalized and do not incentivize informal social gatherings and activities (Mcguirk et al., 2007). Even in a smart city with its high level of connectivity, creating places to pique the interest of the commuter/citizen/tourist will have its advantages. Smart cities, beyond their algorithmic trappings, should strive for city spaces where the individual can get lost, meet new people and engage with a diverse range of people (Foth, 2016).

Measuring the success of urban design projects is often not a prerogative of city governments and private developers. A lack of evaluation often leads to loss of valuable feedback to assess whether space meets its original design intent. Carmona (2014) criticises urban design as a field that rarely subjects its projects to a post-completion occupancy review, a deficiency that is common for building projects in general. One of the issues in obtaining this review is gathering data on the usage of the space. Solutions include the ’smart bench’ project in New York City, where the park bench has sensing capabilities (NYC Parks, n.d.). These benches (see Figure 5.6) when strategically placed in parks, not only facilitate seating but also act as a mobile phone charging station and Wi-Fi hub that could also sense mobile users within range to analyse footfalls to a specific spot. This provides a solution for obtaining occupancy levels at different times during the day and even during different events to predict the success rate of a certain public space. The knowledge base thus garnered could be documented for future similar projects. The technology aspect is a contributor to urban design for smart living than vice versa. It also helps in cost-benefit analysis of urban spaces, that could establish the value of well-designed public spaces.

Figure 5. 6: Smart benches in New York City

Source: NYC Parks (n.d.)

Index	Indicators
B3.3	Culture sensitive design and informal design aspects promote vibrant, happy places
C3	Measuring the impact of urban projects contributes to the city knowledge base on popular places

5.3.4 Urban design and People

The role of smart citizens inhabiting a smart city is one of the most obscure yet interesting areas in the smart cities discourse. While rest of the smart city dimensions focus on factors such as the physical, natural and built environments or governance structures or transport systems, which are all directly controlled by the citizens (in varying capacities), the smart citizen is a parameter which puts that same citizen at the centre of the discussion. Therefore, the question arises on who is a smart citizen or what makes a citizen ‘smart’? Bayar (2017) identifies smart citizens as those who ‘’produce and use information through systems in an efficient and sustainable way in order to form smart cities. Smart cities provide a sustainable environment to implement efficient systems that process information for the use of smart citizens’’. Many of the smart city projects focus on technological interventions, often run by big tech corporations (Sadoway and Shekhar, 2014), which are not always inclusive. In a smart city, the citizens are expected to play a leading role by participating in the city building process. However, the increased interdependence on this digital capitalism will exclude several citizens, who may be technologically illiterate or lack access. Bottom-up initiatives and open, participatory approaches that have the citizen at the centre will contribute to technology democratization and can create a sense of community, that both engages and empowers the citizens (Ferronato and Ruecker, 2018). In this context, the importance of urban design discipline in contributing to smart citizens is reviewed using the smart city wheel indicators.

21st-century education

While the role of citizens in a smart city is envisioned to be more participatory and engaging, the current status of the *Right to the City* (Cardullo et al. , 2019) in terms of participation in the city building process is still ambivalent (Shelton and Lodato, 2019). The right advocating a citizen-centric participatory mechanism is especially relevant in the city, as it is often the most neglected area. In the current climate of digital capitalism, the less technology-savvy citizens face the difficulty of getting pushed to the boundaries of this process. While the level of democracy in the planning process, given to citizens is not universally uniform, some cities go to the extent of educating their citizens to take a more active role in the process. The Smart Citizens Kits project (see Figure 5.7) by Amsterdam Smart City is one such initiative to get citizens to self-collect data and visualize the measurements for analysing air quality, weather conditions, noise and light pollution, using individual devices. Though the first kit was not entirely successful due to some glitches (Zandbergen and Uitermark, 2019), a newer version was released by the city government in 2019 (Amsterdam Smart City, 2019). Through a continual process of testing and improvising using user-friendly technology, the Amsterdam Smart City has demonstrated a model for successful citizen participation. In this model, the citizen becomes the participant and can engage in research by themselves to understand their immediate urban environment while also contributing to the city-wide data collection process. Empowering citizens through these initiatives contribute to the 21st-century education of citizens in a smart city. Though urban design does not contribute to this learning process, it is an essential domain in which citizen learning has to occur for fully inclusive participatory citizenship in a smart city.

Figure 5. 7: Smart Citizen Kit of Amsterdam

Source: Amsterdam Smart City (2019)

Inclusive society

The "New Urban Agenda" adopted in the UN-Habitat III Conference points out the following action areas as necessary for safe, resilient and inclusive urban growth:

- Improving building codes and regulations to ensure an enabling environment for universally accessible buildings
- Building the capacity of policymakers, civil society, and other stakeholders to help improve accessibility, recognise diversity and to involve all in the process.
- Using information and communication technology (ICT) as an enabler for improved data collection, addressing feedback and grievances
- Respecting cultural diversity and promoting participatory design involving all community members belonging to different gender and age groups, to achieve a bottom-up planning process

The first point directly relates to the contribution of planning and design towards achieving inclusive smart cities. However, one of the least discussed aspects is how planning and design decisions in cities can have a strong influence, either to enhance or restrict a sense of belonging among its inhabitants. One of the smart city's primary goals is to ensure inclusivity at all levels, including various socio-economic groups. In a study conducted by Hastings et al., (2005) to understand the public services provisions in the deprived and less deprived neighbourhoods in the UK, it was revealed that there were significant gaps in the amenities provided in the neighbourhoods either due to variations in service standards or unintentional bias. Even though the local authorities provided standardised, uniform services to all residential neighbourhoods, the researchers found a lack of any additional services that were explicitly provided to disadvantaged neighbourhoods. This, in turn, contributed to a widening of the gap in the quality of the neighbourhood environment between deprived and affluent communities. Even though this study is not current and is based on UK cities, there is universal applicability to its findings, especially when it comes to cities in developing countries, thus driving the need for more design interventions for a better quality of life in neighbourhoods of cities.

Index	*Indicators*
B4.1	Universally accessible design of urban spaces promotes inclusivity
B4.2	Design interventions in less affluent neighbourhoods help in improving social balance

Embrace creativity

Cultural industries or creative industries have an essential role to play in the development of cities. Design can be used as a tool to improve the participatory process in the urban sphere, to bring together both the designer and the user to co-design the user space, making them co-creators in the process. Mueller et al.,(2018) present vital research on the citizen design science within the premises of smart cities. They recommend the use of ICT as a creative tool using web applications to involve users in the design process after primary decisions are made by the designers. This combined strategy of technology-assisted urban design can overcome some of the drawbacks of a participatory planning process (see Figure 5.8) that is often expensive and time-consuming. The researchers also identify that this dramatically improves creativity in the whole process with the active engagement of the citizens as co-designers.

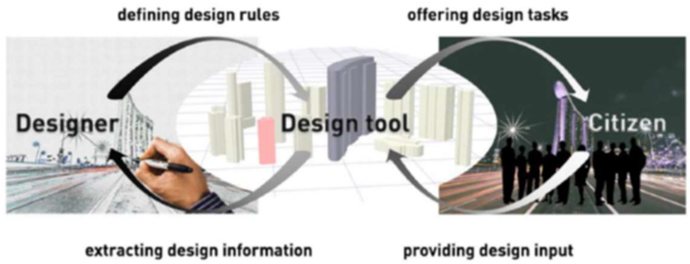

Figure 5. 8: Technology as participatory design tools

Source: Mueller et al. (2018)

Index	*Indicators*
B4.3	Participatory design at the urban level can be enhanced with the aid of ICT

5.3.5 Urban Design and Governance

The interrelationship between good governance and urban design practices in a smart city is another complex correlation to establish. While urban planning policy comes under the direct purview of the city planning or urban development wings of the government, urban design principles and decisions are neither well understood nor integrated as policy (Paterson, 2012). In this context, this section discusses the relevance of the urban design discipline to contribute to good governance.

Enabling supply and demand-side policy

Supply and demand-side policy frameworks are set out by the government to create structural balance in society. At the city level, housing policy is often solely instrumental in either raising costs of homes and lowering affordability or contrastingly, improving the availability of affordable homes. As a result, policymakers need to consider interventions that maintain a balance between supply and demand, paving the way for the inclusive growth of the housing market (Pike et al., 2016). However, moderating urban design through policy is still an ambiguous area. It is challenging to ascertain ‘measurable dimensions’ to urban design and lack of clarity over advantages in employing either a regulatory or discretionary system. However, integrating design into the planning policy leads to high-quality public realm (Punter, 2007). While in countries like India, the introduction of urban design principles in the planning policy is at a state of infancy, The Ministry of Housing Communities and Local Government (2014) in the

UK advocates taking a proactive and collaborative approach in creating well-designed places (Figure 5.9). The National Planning Policy Framework gives the legal right to planners to reject planning permission based on an inferior design that fails to improve the existing local character of the project proposal area.

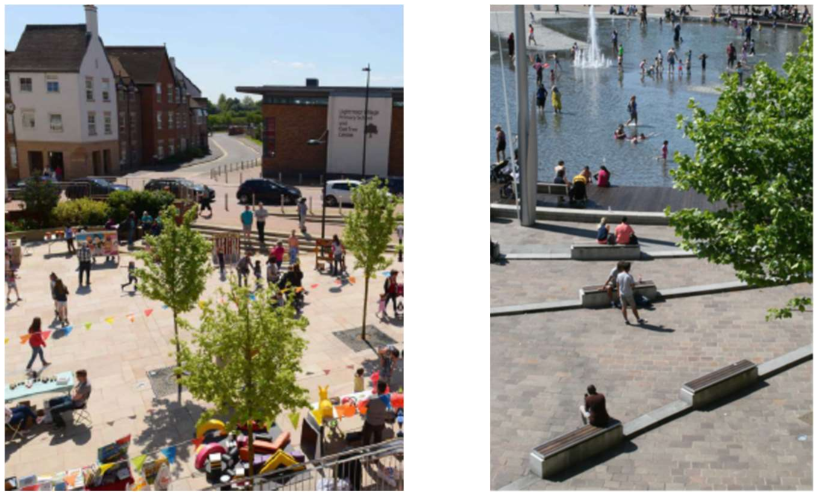

Figure 5. 9: Outcomes of integrated design policy

Image Credit: Ministry of Housing Communities and Local Government (2019)

Index	*Indicators*
B5.1	Integrating urban design into planning policy ensures design control of urban spaces to create high-quality, diverse cities

Transparency and open data

A transparent public sector is a prerequisite for a democratic society, and yet in practice, it is challenging. The use of ICT does not automatically enable transparency as ICT can also be a disabler or a limiting agent to transparency (Janssen et al., 2017). Since urban planning comes in the public sector domain, transparency in urban planning and design is expected mainly in the decision-making process. Mukhopadhyay (2017) advises that given the uncertainties over climate change and other externalities, transparency in the planning process is gaining traction to avoid future conflicts. Open data is useful to planners and designers to design better places. The information gives evidence to improve experimentation of city processes, testing concepts before execution, knowledge sharing and evidence-based planning decisions and (RIBA and ARUP, 2013).

City planners and designers are often criticized for working in silos. The knowledge-sharing aspect of open data enables greater collaboration for mutually beneficial outcomes. The city of Greater Manchester developed the Greater Manchester Infrastructure Map in 2014-15 through an open data platform. The online interactive mapping tool which was created to integrate the social and physical infrastructure across the city region has currently been expanded into four maps to include planning, housing, environment, social, housing, and demographic data. One of the primary uses of the maps is to identify the available lands for development of future housing and jobs sites that would benefit the ten local planning authorities within the Greater Manchester city region (GMCA, 2018). The Greater Manchester Combined Authority (GMCA) in charge of the process identified these sites and further to this, the Draft Greater Manchester Spatial Framework was prepared for consultation in 2016. The vision of the proposal is planning to meet the future growth levels above baseline forecasts and to support long term growth of the city that ensures a resilient Greater Manchester that is also sustainable (GMCA (B), 2016).

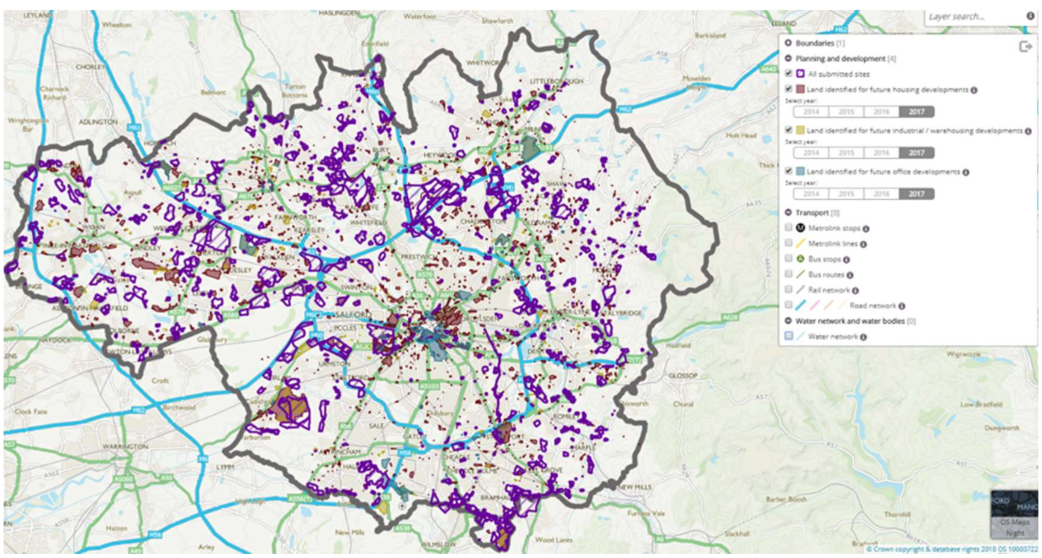

Figure 5. 10: Greater Manchester - Call for Sites Map

Source: GMCA (2018)

Index	Indicators
B5.2	Transparency and open data enable knowledge sharing

ICT and e-Governance

The governance of smart cities can be managed through a centralised, one-stop mobile application, as demonstrated by the Dubai Now app for phones. The application (see Figure5.11) lets users keep track of government applications and utility bills, and can even prompt for an upcoming healthcare appointment, give information on nearby hospitals and pharmaceuticals and places of worship, based on the users' GPS location (Dubai eGovernment Department, n.d.).

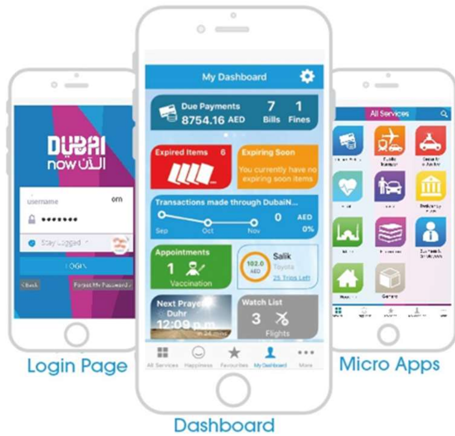

Figure 5. 11: Dubai Now App Screen

Source: Dubai eGovernment Department (n.d.)

5.3.6 Urban Design and Mobility

When it comes to smart cities, urban planning and design have direct causal effects in establishing a well-connected, well-integrated and sustainable transport system.

Mixed-model access

Integrated mobility planning results in a number of benefits including, access (to homes and facilities); continuity (continuous and less fragmented network); safety (from vehicular traffic); directness (following the shortest path); comfort (attention to surfaces and gradients); amenity (attractiveness of streetscape); bike parks and interchange with public transport (Soltani, 2006). To provide connections that allow thorough access for pedestrians is insufficient.

Index	*Indicators*
B6.1	Integrated mobility planning and design contributes to ease of access to mixed-modal transport options leading to sustainable travel behaviours

Prioritized clean and non-motorised options

Good design can often enhance positive behaviour and provide ease of use and convenience that was not thought of before. The need for prioritising clean and non-motorised transport is widely regarded as the future direction for city transport. Copenhagen is a city that has prioritised cycling and framed and delivered a long-term strategic vision on this front. Urban designer Mikael Colville-Anderson through his practice Copenhaganize researched how these sustained efforts have slowly increased the number of cycle users over the last three decades at the same time reducing car usage in the city. The result was due to the shortened travel time through effective short cuts using bikes compared to cars within the central areas of the city

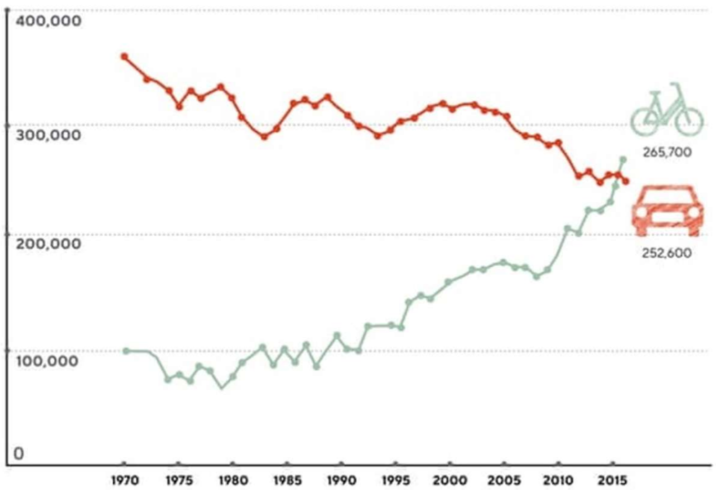

Figure 5. 12: Increase in number of cycles entering Copenhagen city centre

Source: The Guardian (2018) Photo credit: Copenhagenize Design Company

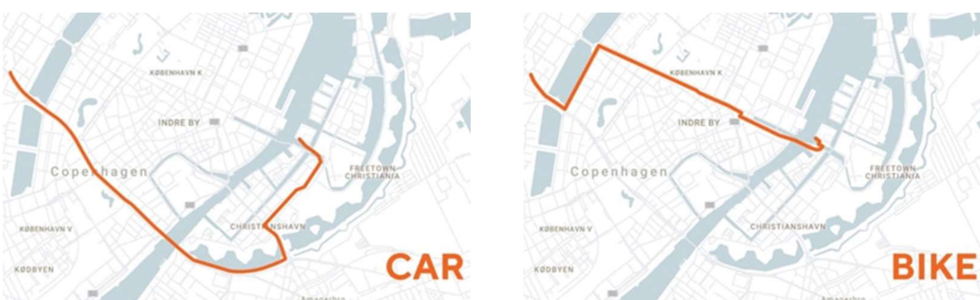

Figure 5. 13: Reduced journey times by cycle through establishing shortcuts

Source: The Guardian (2018) Photo credit: Copenhagenize Design Company

The construction of *Cykelslangen* or 'Cycle Snake' in Copenhagen was completed in 2014 as an exclusive, elevated super way for bikes, connecting the highway with the harbour bridge (Danish Architecture Center, n.d.). While bridges dedicated for cars or occasionally shared between pedestrians and bicycles is the standard convention around the world, the design of the spiral bike-only bridge leaves the pedestrians at the lower level, resulting in a more stress-free and safe way for both cyclists and pedestrians alike. The case of Copenhagen demonstrates how design can influence mobility-related behavioural changes over time. Increasing the privileges offered to cyclists by using incentives such as dedicated bike lanes, bridges, allowing cyclists to maintain a constant pace by removing roadblocks and intersections along long stretches, and finally, when five or more cyclists approach a traffic light, the lights will stay green till they pass, are methods adopted by the city to create this effective transformation (Copenhagenize, 2014).

Index	*Indicators*
B6.1	Dedicated cycle and walking tracks enable ease of access for faster travel by non-motorized transport modes

Integrated ICT

While urban planning and design deal with the spatial dimension of mobility, the time aspects of mobility can be accurately measured through ICT. One of the most successful technology companies in recent years, Uber, a ride-sharing platform, offered to share its data on journeys made within cities to benefit transportation and city planners, This is a big step forward towards addressing traffic congestion through data analysis. The Uber Movement, launched in early 2017, in few cities around the world is currently available (in late 2018) in about 22 major cities around the world (Uber, 2018). According to Gilbertson and Salzberg (2017), with the data generated from the app used by Uber drivers 24/7 and at different times of the day, week, months and year, Uber can help to analyse the impact of significant events, road closures etc., on travel times across the cities. The anonymised data generated by the users and drivers were used to verify the impact of London city's traffic situation during the London Tower bridge closure in late 2016. The analysis of the Uber Movement data revealed that the travel times across the River Thames increased 65 % in the southbound travel direction with approximately a 30 % increase in the northbound direction (Uber Movement, 2018)

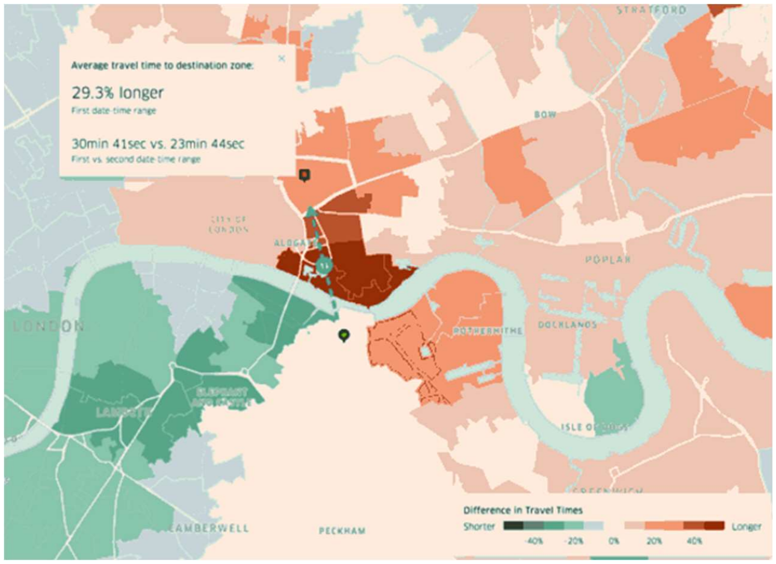

Figure 5. 14: Map indicating the zones with increased travel times (red) and decreased travel times (green) in London in 2016

Source: Uber Movement (2018)

Index	*Indicators*
B6.2	Integrated mobility planning and design contributes to ease of access to mixed-modal transport options leading to sustainable travel behaviours

5.4 Urban Design – The Seventh Dimension

In the theoretical smart city models by Giffinger et al., (2007); and Cohen (2012) wheel, presented in chapter two, the place-based component was not well established in smart cities. Although several indicators within the six-dimensional framework had a spatial connection in varying degrees, there was no specific dimension dedicated to urban design. In Giffinger et al's model, there is no specific factor (action area in Cohen's model) related to urban planning. Some factors like attractivity to natural conditions and cultural facilities are closely associated indicators. In Cohen's model, green urban planning is specifically attributed as an action area and is inclusive of three indicators, namely, climate resilience planning, density, green space per capita (see Annexure-B). Urban planning is an important indicator that is already included within the domain of smart environment.in Cohen's model. However, a mere focus on urban planning without the design aspects cannot be conclusively substantiated and is open for debate. Urban design's role of being a 'filler discipline' to interface between urban planning and architecture, does not hold good any longer. Urban design has gained serious traction as an instrument in shaping places within the broader urban context. In short, a separate set of action areas or principles that contribute to good placemaking in smart cities is essential. Urban design principles for a smart city should be both directive of the desired outcome for good quality places, as well as a benchmarking tool.

The previous section has been an attempt to demonstrate the pervasiveness of urban design's contribution to the six smart city dimensions. Though some of the direct causal effects are relatively easy to establish, it is challenging to associate certain other benefits due to difficulty intangibly measuring those linkages. For instance, it is easier to illustrate urban design's contribution to increased economic value due to enhanced capital values, a good return on investments, contributing to productive workforces, increasing place identity, placing developments above the competition and increasing confidence in investment and development opportunities. In the case of some other indicators like twenty-first-century education for smart citizens, it can be seen that it is the technological tools within the smart cities model that contributed to better urban design outcomes, as in the case of Amsterdam Smart City Tool Kit. In spite of challenges to establish these interlinkages, several critical areas of contributions have been identified. The collated list representing each of the six dimensions is listed in Table 5.1.

Table 5. 1: Interface between Urban Design and Smart cities

	Index	Key contributions of Urban Design to Smart city dimensions	Indicators
ECONOMY	B1.1	Image of the city promotes investment	Image
	B1.2	Legibility, accessibility and street-level activity encourage business	Legibility
	B1.3	High-quality public realm promotes productivity	High-quality public realm
	B1.4	Compact, walkable neighbourhoods reduce absenteeism and boost productivity	Walkability
	B1.5	High-quality urban places stimulate the local and regional economy	Economic stimulation

ENVIRONMENT	B2.1	Energy integrated planning and design reduces energy demands	Energy integrated planning and design
	B2.2	Green rating systems for public places encourage sustainable practices	Design-thinking
	B2.3	Compact urban forms reduce energy demands and pollution	Energy savings
	B2.4	Design thinking in planning improves sustainable practices	Sustainability
LIVING	B3.1	Well-designed green spaces promote physical and mental well-being	Green spaces
	B3.2	Crime prevention through urban design minimises the incidence of crime	Crime prevention through design
	B3.3	Culture sensitive design and informal design aspects promote vibrant, happy places	Culture sensitive design
	B3.4	Measuring the impact of urban projects contributes to the city knowledge base on popular places	Knowledgebase
PEOPLE	B4.1	Universally accessible design of urban spaces promotes inclusivity	Universally accessible design
	B4.2	Design interventions in less affluent neighbourhoods help in improving social balance	Inclusive design interventions
	B4.3	Participatory design at the urban level can be enhanced with the aid of ICT	Participatory design
GOVERNANCE	B5.1	Integrated urban design into planning policy ensures design control of urban spaces to create high-quality, diverse cities	Design policy
	B5.2	Transparency and open data enable knowledge sharing	Knowledge sharing
MOBILITY	B6.1	Dedicated cycle and walking tracks enable ease of access for faster travel by non-motorized transport modes	High-speed cycling and walking corridors
	B6.2	Integrated mobility planning and design contribute to ease of access to mixed-modal transport options leading to sustainable travel behaviours	Integrated mobility design

While the above twenty indicators are crucial to achieving good urban design outcomes, some of the indicators overlap with the indicators already presented in the Cohen smart cities wheel. In order to avoid repetition, Table 5.2 compares the smart city indicators with Cohen's model and identify the missing elements. The highlighted indicators represent the gaps in addressing the 'place' based requirement in a smart city, supporting the position for urban design as the seventh dimension in this model. In addition to the below-identified indicators, creating a sense of place is a key guiding principle that enhances the quality of living in a built environment. 'Sense of place', which embodies the key connection between people and places, focuses on the perception of the built environment. The physical quality of place is an important contributor to evoking 'sense of place' (Hu and Chen, 2018) in a street, neighbourhood and at a city level. As highlighted in section 1.1 of chapter one, evoking a 'sense of place' (place-centric approach) in a 'place of senses' (technology-centric approach) is crucial in a smart city. Therefore, a sense of place is included as an indicator in the table below.

Table 5. 2: Contribution of urban design towards smart cities

S.No.	Action areas	Relative smart city dimensions
1	Image	*Not included*
2	Legibility	*Not included*
3	High-quality public realm	*Not included*
4	Walkability	MOBILITY - Non-motorised transport options
5	Economic stimulation	ECONOMY - Productivity
6	Energy integrated planning and design	*Not included - can be addressed through green urban planning*
7	Design-thinking	*Not included - can be addressed through design policy in green urban planning*
8	Energy savings	ENVIRONMENT – Green energy
9	Sustainability	ENVIRONMENT- Not specified but embedded
10	Green open spaces	ENVIRONMENT – Green urban planning
11	Crime prevention through design (CPTED)	*LIVING -Safety aspect is partially covered but not through design enabled process. This could be an extension of the existing indicator of crime prevention*
12	Culture sensitive design	*Not included - can be addressed as an integral part of other urban design principles*
13	Knowledgebase	PEOPLE – 21st-century education
14	Universally accessible design	PEOPLE- Inclusive society
15	Inclusive design interventions	PEOPLE- Inclusive society
16	Participatory design	PEOPLE- Inclusive society

17	Design policy	*Not included - can be addressed as an extension of green urban planning action area within smart cities model*
18	Knowledge sharing	PEOPLE – 21st-century education
19	Integrated mobility design	MOBILITY – Mixed modal access
20	High-speed cycling and walking corridors	MOBILITY - Non-motorised transport options
21	Sense of place	*Not included*

From the above table, nine action areas highlighted in blue and grey colours. are identified as not addressed in the various smart city models. Out of the nine action areas, energy integrated planning and design *(S.no.6)* indicator (highlighted in grey) can be included as part of the green urban planning action area. Similarly, design thinking *(S.no.7)* indicates a general awareness and inclination towards good urban design. Design thinking or design approach is essential to set priorities and gain an understanding of the value of the discipline. However, this action area, too, can be addressed along with the design policy. Similarly, the smart living dimension in models developed by Giffinger's team and Cohen clearly addressed the need for crime prevention and safety in smart cities. The only refinement required is to enhance the crime prevention aspect through design *(S.no.11)*. Next, the need for culture-sensitive design *(S.no.12)* is an action area that is enabled through contextual planning and design. As stated earlier in the chapter, successful public spaces are planned considering the "geographic, temporal, social, cultural, economic, political, institutional and environmental" contexts (Wheeler, 2016, p.48). Therefore, the culture-sensitive design is an intrinsic value associated with urban design rather than a principle. Similarly, urban design policy *(S.no.17)* should be integrated with urban planning policies. Although this research has continuously argued for the case of a distinctive role for urban design within a smart city, this author also acknowledges that urban design cannot stand without urban planning as its foundation. Separate urban design policy is required, preferably at national, state and city levels but should be positioned in relation to the planning policy (see section 6.6). Therefore, design policy is not included as a separate activity area, thereby bringing the number of action areas related to urban design to seven However, the important question to consider at this juncture is to analyse if these action areas are comprehensive to be identified as principles of urban design in a smart city. The review necessitates the need to look at seminal works on urban design to assess the suitability and completeness of the six areas identified.

At the beginning of this chapter, views of many authors (Khansari et al., 2014); Bhattacharya et al., 2015; Min et al., 2019) who identify smart cities as a means to achieve sustainable development was discussed. Drawing upon this inference, indicators for urban design in a smart city has to address better placemaking and also be a means to achieve sustainability of the urban form. Two decades ago, Frey (1999), in her significant work, demonstrated the prominent role of urban design in contributing to sustainability. Frey identifies eight principles as important indicators for sustainable urban design. Similarly, Jabareen (2006) and (Clarke, 2009) propose a separate set of indicators for design supporting urban sustainability. Table 5.3 compares the distinguishing elements advocated by each of the three authors.

Table 5.3: Elements of sustainable urban design
Source: Adapted from Frey (1999); Jabareen (2006); Clarke (2009)

Frey (1999)	Jabareen (2006)	Clarke (2009)
Mixed-use	Mixed-use	Mixed-use
Sense of place	Diversity	Social infrastructure
Imageability	Greening	Density
Green space and public open space	Compactness/density	Long-term maintenance
Adaptability	Sustainable transport	Public transport
Public transport options	Walking and cycling	Walkability
Local autonomy	Passive solar design	Urban management
Low pollution and noise		

Elements like ‘public transport options’ (mobility dimension), ‘local autonomy’ (governance dimension), ‘low pollution and noise’ (environment dimension), indicated in table 5.3 are already ingrained in the smart city wheel model, either distinctly or as a hidden outcome of another action area. Furthermore, the terms legibility and imageability are often used interchangeably, as observed by Lynch (1960). Moreover, the term ‘legibility’ presents itself more clearly as a concept. Similarly, ‘diversity’ is seen as an outcome of “varied physical design, mixes of uses, an expanded public realm” (Fainstein, 2005, p.3) to encourage social gatherings in public places. As diversity is dependent on other elements like mixed-use and public realm, it is an implied element and therefore not considered as an independent element. Therefore, six urban design elements are determined from the above analysis. In order to gain a deeper understanding, the definitions for the six elements, as identified in the literature are presented below:

1. Mixed-use - "A mixed-use development is a real estate project with planned integration of some combination of retail, office, residential, hotel, recreation or other functions. It is pedestrian-oriented and contains elements of a live-work-play environment. It maximises space usage, has amenities and architectural expression, and tends to mitigate traffic and sprawl."

Niemira (2007, p. 54)

2. Sense of place - Sense of place means a "complex of intangible characteristics of place that make it attractive to actual and potential residents and influences their behaviour in observable ways'

Bolton (1992, p.193) cited in Worthington (2000, p.349)

3. Legibility- "means the apparent clarity or legibility of the cityscape…the ease with which its parts can be recognised and can be organized into a coherent pattern. "

Lynch (1960, p.2-3)

4.Adaptability – Adaptability is the capacity of urban buildings, neighbourhoods and spaces to adapt to changing needs.

Ministry for the Environment (2019)

5.Compactness– compactness is characterised by high density of built-up areas and short commuting distances between homes, services and work

Schwarz (2010)

6.Public realm – all the parts of the urban fabric to which the public have physical and visual access. Thus, it extends from the streets, parks and squares of a town or city into the buildings which enclose and line them

Tibbalds (2001, p. 1)

Based on table 5.2 and 5.3, and in addition to the above discussions, the key urban design elements identified are 1. Mixed-use; 2. Sense of place;3. Legibility; 4. Adaptability; 5. Compactness (promotes density) and 6. Public realm. The comparative process and the key urban design action areas required in a smart city are presented in Figure 5.15.

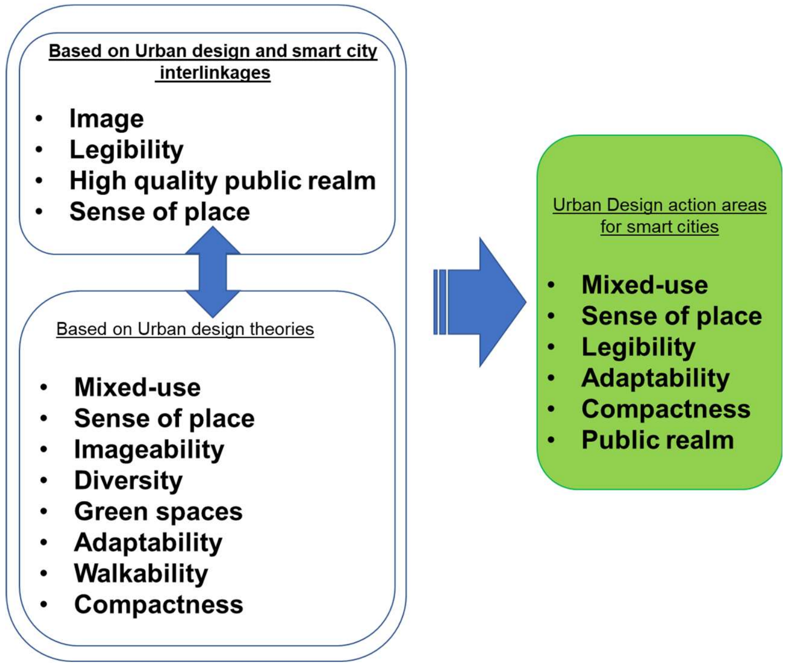

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Figure 5. 1515: Urban Design action areas for a smart city

Source: Author's elaboration

The demonstrated need for positioning urban design in a smart city necessitates the need for a new smart city model. The new theoretical model proposes urban design as the seventh dimension, positions urban design as a distinct yet contributing dimension to the other six dimensions. The six dimensions are represented like six petals on a symbolic flower, with the urban design dimension forming the central corolla of the flower in the model. Due to the overarching role of urban design as a common contributing factor for the remaining six dimensions, it is placed centrally within the core area of the model (Figure 5.16).The six key urban design elements evolved through a three-step process. First, through qualitative analysis of literature to establish urban design's role in a smart city and identifying twenty-one key contributing elements in the process. The second step involved comparing the evolved elements with the existing indicators theoretical models (Cohen and Giffinger et al.) and filtering it to four important elements. The final step involved comparing the identified elements with theories on sustainable urban design, to derive the six urban design elements or action areas for a smart city.

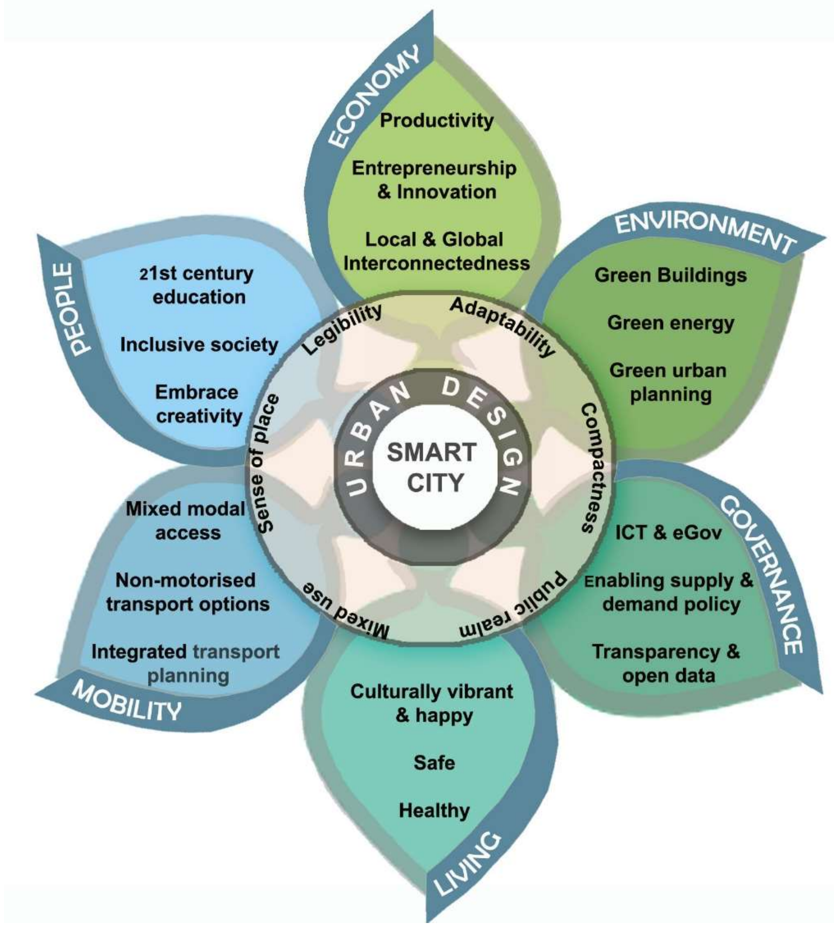

Figure 5. 6: A Proposed theoretical model for smart cities (based on Cohen's wheel)
Source: Author's elaboration

5.5 Conclusion

The principal theoretical implications of the analysis in this chapter helped in understanding the role of urban design in enhancing the smart city model. Through the review of literature and from good practice example, establishing the linkages between urban design and smart cities represent the theoretical premises for positioning urban design within the smart cities model. This chapter further explored the connections to strongly argue for a distinctive position for urban design, representing the 'place' based design approach in a smart city. Further to establishing the connections, a new theoretical model for smart cities is then proposed with urban design as a unifying and contributing seventh dimension of the model. The next chapter further explores this premise by looking into the role of urban design in India's SCM.

CHAPTER 6

SMART CITY MISSION OF INDIA: URBAN DESIGN CONSIDERATIONS

6.1 Introduction

This chapter investigates primarily, the objectives of the SCM in India and its proposed manifestation in Indian cities. While the chapters two and five established the importance of urban design in a smart city, this chapter attempts to address research question two on the significance of urban design to India's SCM. This is achieved by examining the intended mission outcomes of the first twenty cities selected through the city challenge process of the mission. The chapter consists of four sections: the first section investigates early attempts to build smart cities in urban India that were proposed before the launch of the SCM, to understand India's early attempts in the smart cities foray. The second section analyses the SCM document to understand the objectives of the proposals. The 3rd section looks in more detail at the first twenty of the one hundred cities that were chosen in the first round of the city challenge competition in the mission, to establish critical interlinkages to urban design priorities in those cities.

6.2 Early precursors of the mission

The first groundworks for improved cities in India were the 10-year Mega City Scheme initiated in 1993, which faced several funding issues (Chakravorty, 1996). Following this, Jawaharlal Nehru National Urban Renewal Mission (JNNURM) was launched in 2005 as a flagship urban scheme that looked at improving urban governance and services. JNNURM marked a significant transition point as for the first time, authority and power was granted to the Urban Local Bodies (ULB) in implementing the various schemes. However, as highlighted in chapter three, the mission was not hugely successful as it became crippled by funding delays and incomplete devolution of the authority to ULB's (Aijaz, 2008; Weinstein et al., 2009; Weinstein et al., 2014). Therefore, the huge gap in policy initiatives also contributed to various developmental deficits in Indian cities.

Although, the seed for developing smart cities in India was first initiated in the twelfth five-year plan that commenced in 2012. There were interests in parts of India in developing new smart cities., even before the actual launch of the SCM. The report prepared by the Netherlands' Enterprise Agency under the Ministry of economic affairs and climate policy (Agentschap NL, 2011) outlines the various attempts in the smart city direction. One such proposal was the development of seven new industrial cities as 'smart cities' along the Delhi-Mumbai industrial corridor (DMIC). The ambitions of the DMIC project are to align the development of these cities to support the 'Make in India 'drive targeted for industries and businesses. The DMIC is one of the five major industrial corridors (see Figure 6.1) proposed in the country, which aims to strengthen, and connect existing industrial belts and create new economic centres for fostering more significant economic developments. Scholars in recent years have argued against the increase of similar satellite towns and new cities, as they are viewed as a move towards 'assemblage urbanism' (McFarlane, 2011) and 'worlding' of cities (A Roy and Ong, 2011). Such attempts are also a reflection of 'global privatisation of urban space' (Hogan, Bunnell, Pow, Permanasari, and Morshidi, 2012). The merging of adjacent settlements that were once independent cities or towns or villages into a continual urban area is considered the antithesis to compact city form by some researchers (Angel et al. 2018). Nevertheless, in India, the drive to increase economic growth outweigh all these qualms and pushes these hurried settlement developments as ways for fast-tracking growth.

The Delhi-Mumbai Industrial Corridor (DMIC) was initially intended to be the first destination for smart city developments, that would crisscross six Indian states along the North-Western part of India. This project, developed in co-operation with Japan with, is expected to be a manufacturing and trading hub, which will also have new cities along the dedicated rail freight corridor. The new cities are targeted to have world-class facilities like a mass rapid transit system, dedicated bicycle, and walking tracks, total waste management solutions, smart grids for digitally managing energy consumption and 24-hour power and water supplies. The first of the cities proposed at Dholera investment region is about 110 km from Ahmedabad in the state of Gujarat (see Figure 6.2). Plans are in place for interlinking the new cities with new airports, rail links, arterial roads, and highways. Some of the innovative ideas proposed include. underground parking corridors, dedicated sewage and communication network lines, dedicated corridors for light rail and bus routes that would also enable the availability of public transport within a 10-minute walk (Agentschap NL, 2011). The DMIC project inspired by the Tokyo-Osaka Industrial Corridor is part of the Golden Quadrilateral (GQ), which is the fifth-largest freeway project in the world that is planned to link the four Indian megacities of Delhi-Mumbai-Chennai-Kolkata. Dholera, a new city launched in the early part of this decade, is planned as a smart city along the DMIC.

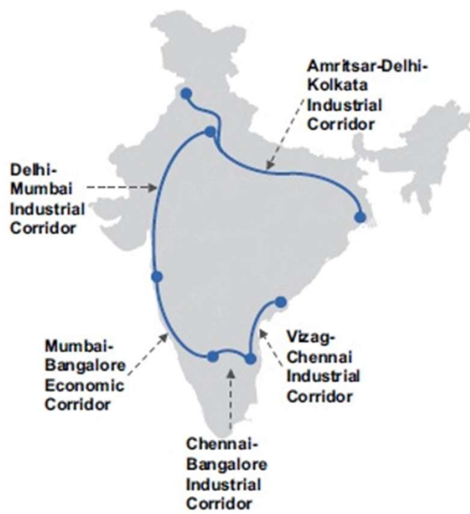

Figure 6. 1: The Five Industrial Corridors.
Source: World Economic Forum (2015)

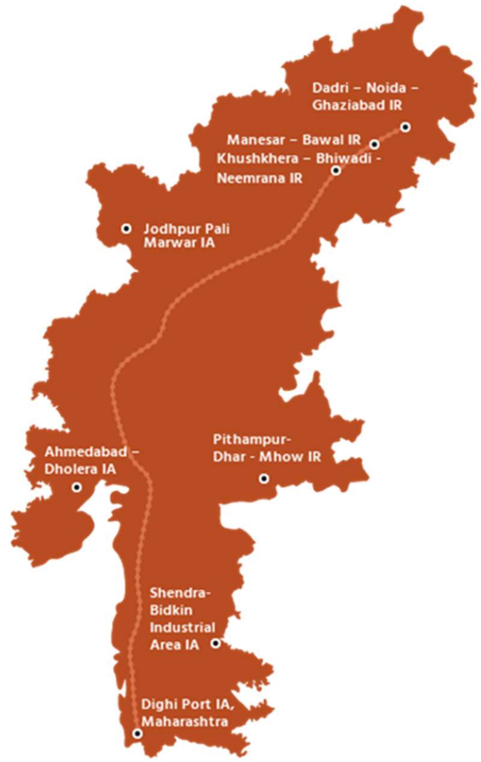

Figure 6. 2: Delhi Mumbai Industrial Corridor,
Source: DMIC (2018b)

6.2.1 Dholera- A pilot smart city

Dholera, in the western state of Gujarat, India is touted as the first of the smart city projects designated as the pilot project for the 100 new cities to be built in the next few decades. The project is a joint venture between the Indian government and Japanese corporations. Dholera was originally a small low-lying, agricultural village that will be grouped with 21 other villages to form the 'Dholera smart city'. The city is an outcome of the Special Investment Region (SIR) Act passed in 2009 by the state of Gujarat in Western India. The city, marketed as a pinnacle of technology-based urbanism, is visualised in a 903 sq.km area which is almost twice the size of present-day Mumbai. Often highlighted as a new city that will not have any of the everyday ‘annoyances’ of a typical Indian city like, congestion, pollution and informal settlements, Dholera is designed to be a combination of globally recognised urban practices such as new urbanism and eco-city, blended with the seamless urban life promised by Cisco (global information technology company) through a mesh-work of sensors, cameras and fibre-optic cables (Datta, 2015).

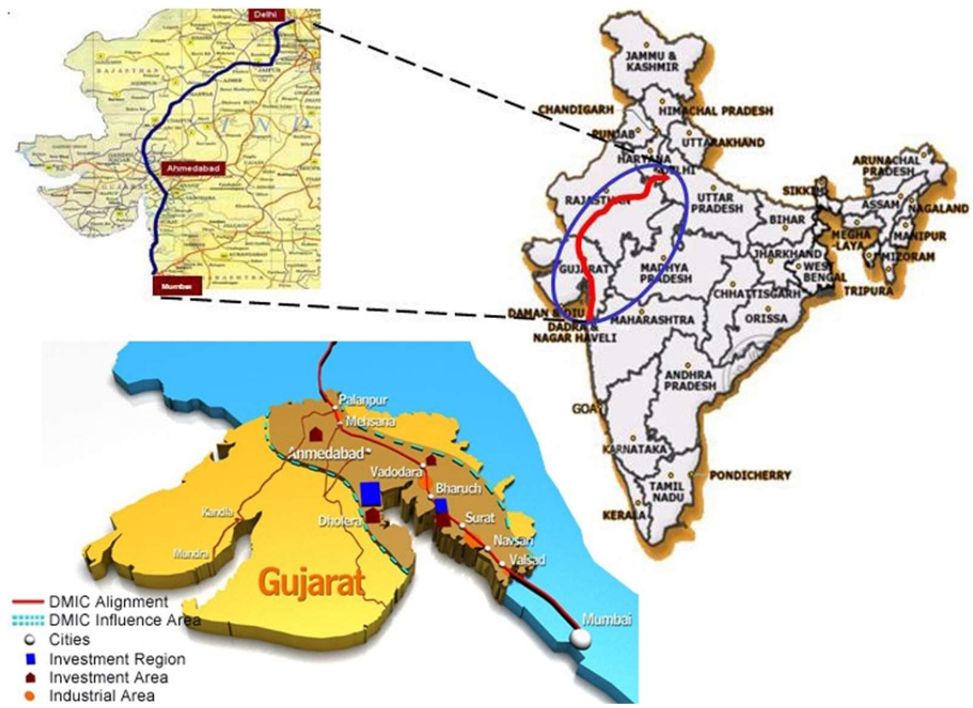

Figure 6. 3: Dholera Smart City
Source: GIDB (2016)

Dholera Special Investment Region (DSIR) is one of the most ambitious projects with the city planned as a strategic nodal city due to its proximity to nearby cities of Vadodara, Ahmedabad, Surat, and Rajkot. The development is proposed in a phased manner with a central core of the activation area of 22.5 sq.km., designed to attract local and global investment. The city envisaged as a plug and play city to attract investment from global manufacturing industries and businesses (see Figure 6.5), is touted as a ‘role model for greenfield smart cities in India’ (DMIC, 2018a).

Figure 6. 4: Vision for Dholera Smart city

Source: DMIC (2018a)

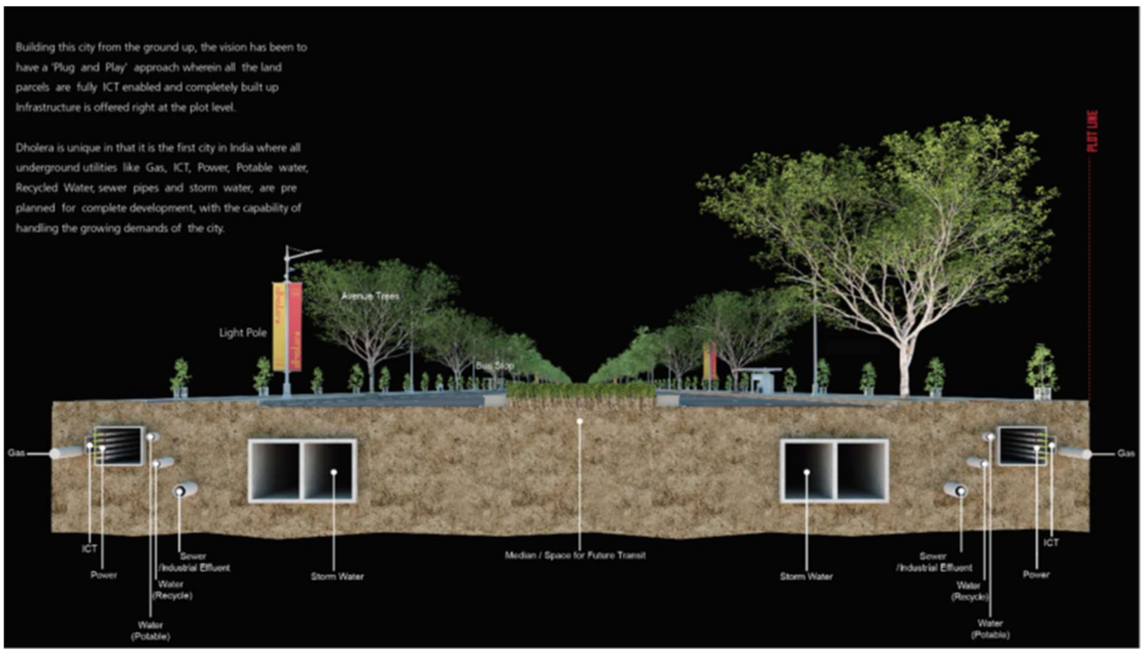

Figure 6. 5: Plug and Play city model

Source: GIDB (2016)

Datta (2015) identifies Dholera with the emergence of a long genealogy of city building in post-independent India, following planned cities like Chandigarh, Bhubaneshwar, Jamshedpur to the recent eco-city of Lavasa. However, she raises the concern that Dholera is not addressing the challenges of continuing social inequalities and exclusions. Also, Dholera represents a classic case of 'entrepreneurial urbanism' by the state of Gujarat, which is striving to make the city an economic success through 'big, bold' policies that have similarity to the term 'instant urbanism' coined by (Murray, 2013). This approach is a deliberate shift towards city-building through private partnership, that is prevalent in countries of the global south such as China, Malaysia, Korea and Brazil. Dholera, as a smart city, will be highly dependent on the technocratic model of urban governance that will be orchestrated by corporate interests that which will control and monitor everyday life. Datta (2015) criticises that there have been only policies, master plans and 3D simulations presented as future city vision, more than progress on site. Since the original planning approval in 2009 for an industrial township, Dholera has had few different city labels. Jazeel (2015) also criticised the imagined future-city-to-come rhetoric of Dholera and the contrasting ground reality of Dholera's rural character. The then Gujarat State Government's forceful land acquisition from the farmers under the Special Investment Region Act of 2009 is criticised as an act of urban utopianism sold by the government, to 'legitimise the promises made (Datta, 2015). The various criticisms by the observers are valid as the real success of Dholera can be measured only after the completion of the city.

6.2.2 GIFT city and Smart Kochi initiatives

Another contender for the title of India's first smart city project is the GIFT City (Gujarat International Finance Tec-city), again proposed in the western state of Gujarat. The city aims to have a CBD area of 3.58 sq.km and claims to be the futuristic global financial hub that will compete against the likes of similar financial districts such as Shinjuku (Tokyo), La Defense (Paris), Dockland yards (London),and Lujiazui (Pudong). The master plan of the city envisages a transit-oriented development with four transit stations spread across the area for walkable access within a 500-meter radius (see Figure 6.6 and 6.7). Both Dholera and GIFT city projects are greenfield cities were proposed during the tenure of Narendra Modi, (2014-till date) Prime Minister of India, who was then the Chief Minister of the state of Gujarat before his ascent to the Prime Ministership. Some argue that the big policy rollouts which resulted in a perceived economic miracle in the 'Gujarat model' did not deliver results at the national level including grand missions like the smart cities and the Make in India campaign (Mukherjee, 2018). While Dholera has not made much headway, GIFT city has been making slow yet steady progress. A few office towers stand completed, and the World Trade Centre is also proposed for construction. The GIFT (2019) city website identifies the city as "a Smart City in every sense with Urban Planning adhering strongly to green-building principles and highest standards of efficiency in terms of energy and environment friendliness".

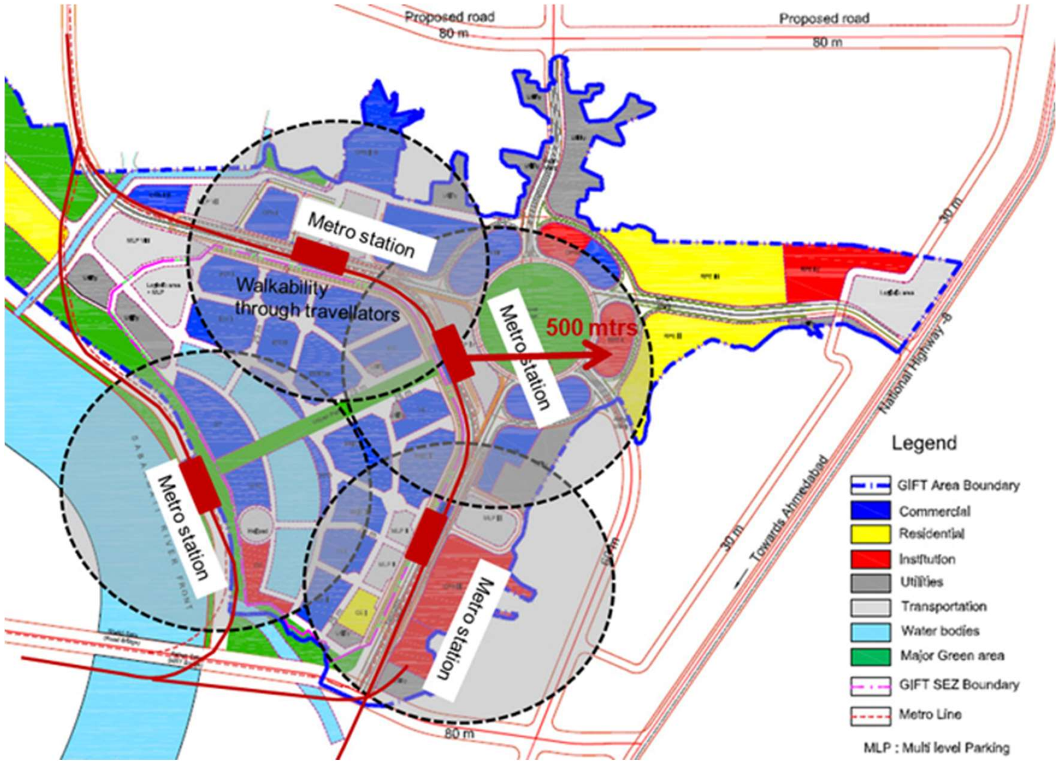

Figure 6. 6: GIFT city Master Plan

Source: GIFT (2019)

Figure 6. 7: GIFT city Central Business district

Source: GIFT (2019a)

Among the other, most notable attempts, is Kochi (SCK), a special economic zone based on information technology services (Smart City Kochi, 2018). It is the first development marked with the 'smart' tagline in India. It is jointly promoted by the state government of Kerala and the global investment company Dubai Holding, which is the primary stakeholder. The 246-acre township on the outskirts of Cochin city boasts a reliable and advanced ICT infrastructure for enhanced connectivity for businesses in the township. The township proposes a mix of high rise and medium-rise residential apartments with smart living amenities including luxury executive apartments, a school for 3000 students, retail space, in addition to potential hotel projects by external investors. The original project was proposed in 2007 for completion within ten years, but despite some stumbles with the first phase of the project, the remaining two phases are expected to be completed as per schedule (The Hindu, 2017).

Figure 6. 8: Smart city proposal Kochi

Source: Smart City Kochi (2018)

The future smart city projects of Dholera, GIFT city and Kochi were greenfield development sites. The success of the above cities is challenging to predict as many new cities in recent history are considered ghost towns, including the smart city of Songdo, South Korea (Shepard, 2018). Smart City Kochi was mainly developed as a Special Economic Zone (SEZ) project that would function as an IT hub for business and attract foreign investment in the state of Kerala. Residential accommodation buildings and other ancillary infrastructure facilities were developed to serve the IT workers. On the other hand, Dholera and GIFT cities are developed to attract foreign investment in banking and other commercial sectors. Kochi Smart city is in the advanced stage of development when compared to the other two projects. The master plan of GIFT city has several good planning objectives such as transit-oriented development with train stations, walkability, and protection of existing water canal and green areas at the periphery of the water body. The attempt to sustainable planning practices in the new developments sets an example to the one hundred smart cities mission. Yet, given that the mission cities are all existing, well-established cities of different scales, they come with their rigid city structure. Therefore, some of the planning strategies proposed in Dholera or Kochi may not be possible to implement. However, some of the current day urban planning and design ideas in these cities can become a model for future Indian cities.

6.3 Outline of the Smart Cities Mission

The twelfth and final five-year plan proposed by the Planning Commission of India mentions smart cities as a future city strategy. The SCM was launched within the early days of winning the election by the Bharatiya Janata Pary (BJP) in 2014. Following this, a sum of INR 7060 crores (USD 1.16 billion -assuming $ conversion rate of INR 61) was allocated in the July 2014 budget for the development of 100 smart cities. The initial announcement identified developing new satellite towns for larger cities and modernising mid-size cities (Srinivas, 2014). Within a few months after the announcement, the draft concept note for the mission was released in December 2014. Again in the 2018 budget, a revised total investment of INR 204,000 crores (USD 33.44 billion) was announced for the selected 98 smart cities (ET Bureau, 2018). Bunnell (2015) identifies India's smart city vision inclusive of brand-new cities and 'smarter' versions of existing cities, as unprecedented in terms of scale and ambitions anywhere in the world. Bunnell (2015) compares India's efforts with a sense of déjà vu with that of Malaysia's intelligent cities of Putrajaya and Cyberjaya along the 50km stretch Multimedia Super Corridor (MSC). The three common themes identified between the two missions is first the association of Prime Ministers of Malaysia and India (past and present) as the drivers; secondly initiating pilot projects before nationwide implementation with Gujarat being the case in India; and thirdly, the sense of urgency and fast-tracking the projects in both cases.

The hastiness of the mission has pushed cities with varying sizes and population levels into the cities challenge, which is integral to the mission. Cities that do not necessarily have previous experience to visualise, plan and execute urban revitalisation projects, especially the non-metro and smaller cities. Ribeiro (2016) gives a telling commentary on the issues of urban governance in smart cities. He states that the primary target of the SCM should be to ensure workable urban governance platforms, an investment that will be integrated nationally. The author notes the differences in the selection process adopted by the SCM and implementing states in choosing either an inner-city renewal / extended city retrofitting/ greenfield development within each city. Along with large mega-city regions and major municipal corporations, several small and upcoming settlements like the atoll island of Kavaratti in Lakshadweep islands have also been included in the process.

For the first time in the history of city building in India, the smart cities selection process adopted a nationwide 'city challenge' that was deemed both impartial and transparent by many observers. The Ministry of Urban Development (MoUD) in 2015 invited the state governments to submit an expression of interest on cities that they proposed to develop as smart cities. Further to submission by the 29 Indian states[3], a total of 98 smart cities were finalised (see Figure 6.9 and Table 6.1). The state of Uttar Pradesh did not shortlist one city from its allocated number of 13 cities, while Jammu and Kashmir state did not submit its proposal on time. The next stage involved the city challenge wherein the 98 cities (see Annexure- C) submitted detailed smart cities proposal reports that led to the selection of the first set of 20 cities for implementation. The cities had submitted proposals on two levels of development; namely, i) area-based development – proposal for urban redevelopment with smart city features within an identified city region, ii) and pan-city development – smart city proposal for the entire city (Smart Cities Mission, 2017). While the area-based development included several elements in terms of urban regeneration and smart city elements, the pan-city development included only one or two proposals.

[3] As on 1st November 2019, the number of states in India was reduced to 28 from 29. The state of Jammu and Kashmir has been bifurcated to two union territories of Jammu and Kashmir, in addition to Ladakh.

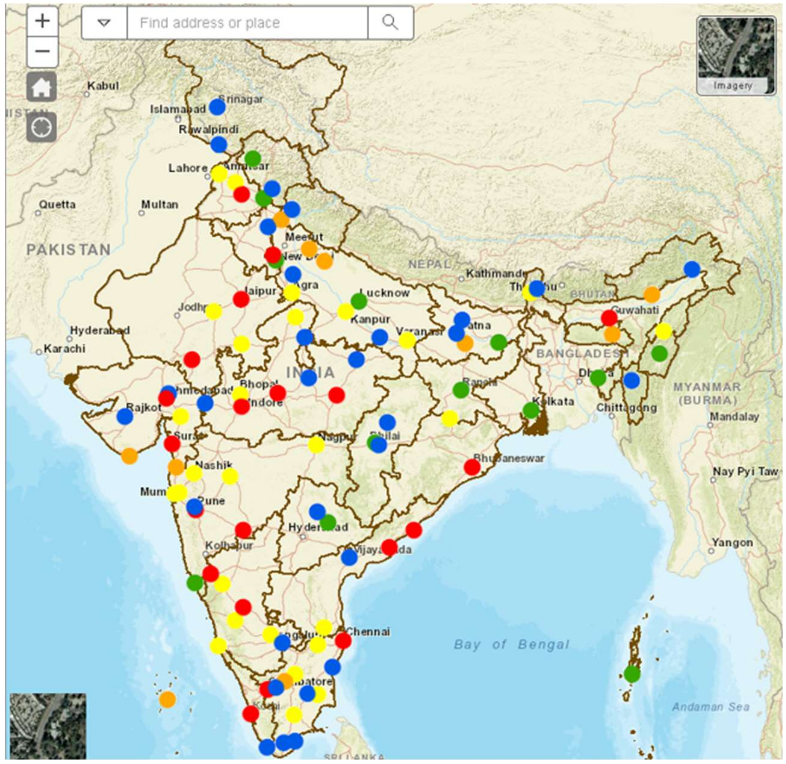

Figure 6. 9: Location of 100 smart cities

Source: MoUD (2015)

According to the Smart Cities Mission document (MoUD, 2015), the mission is carried out as a two-step strategy, area-based development and pan-city development. Area-based development refers to developing a specific area within a city, using one of the three possible approaches, namely, *retrofitting, redevelopment* or developing *greenfield* sites. *Retrofitting* is described in the mission document as "planning in an existing built-up area to achieve smart objectives and also to make the area more efficient and liveable". *Redevelopment* is identified as the "renewal of the selected built-up area enabling co-creation of a new layout, supported with enhanced infrastructure, mixed-use and increased density". *Greenfield* site refers to "the development of vacant land of more than 250 acres with innovative planning techniques in addition to the provision of affordable housing and accommodating the urban poor". The document identifies greenfield development as a necessary tool to address the growing population demands.

Any one or more of the above three approaches can be followed by the mission city in an identified area as a pilot proposal, that is intended to function like a 'lighthouse' for rest of the city. The mission guideline (MoUD, 2015) states that the development area should be identified in consultation with the community citizens, with a total area of more than 500 acres. The area developed should contain intensive infrastructure improvements and smart applications, that can be completed within the allocated time frame of five years. Under the pan-city proposals, the cities are expected to apply city-wide smart solutions based on ICT. The solutions identified are required to involve the use of technology to improve productivity and quality of life for the citizens.

Following the launch of the mission, the state governments were asked to nominate cities for the mission, and 100 cities were announced in stages, following the city challenge process. Table 6.1 lists the timeline of the city challenge process and Annexure-C lists the cities selected in the city challenge rounds along with its respective state/union territory. Shillong was the last city to be added to the list of cities in mid-2018. The total number of cities adds up to 100 cities. Though most government documents identify this as one hundred cities, in reality, it is only 99 cities. New town Kolkata, a satellite city of Kolkata, withdrew after the state government decided to opt-out of the mission (Ghosal, 2016).

Table 6. 1: Timeline of Smart Cities Mission (Adapted from India's Smart city challenge)
Source: Compiled from Smart cities mission website (www.smartcities.gov.in)

Year	Activity
June 2015	Government of India launched a mission to develop 100 smart cities with an allocation of USD 700 million funds over five years.
June 2015 – July 2015	Competitive selection of 100 cities spread over all states based on self-selection by respected state governments using pre-determined capacity benchmarks and performance indicators as set out by the selection criteria of SCM
August 2015	98 cities announced as shortlisted and were directed to prepare smart city proposal for the competition using criteria specified
August 2015 – December 2015	Participating cities developed an area-based approach and pan-city proposal. Cities identified their Vision, Mission Statement, and Smart City Plan based on the city's context, available resources, and citizen priorities.
January 2016	Round 1 - 20 cities were announced based on the standard of their proposal and were allocated funding

March 2016- April 2016	Additional 13 cities were announced following revised proposal submission, to have even distribution across the country.
September 2016	Round 2- 27 cities announced in this round of the challenge
June 2017	Round 3- 30 cities announced in this round of the challenge
January 2018	Round 4 – 9 cities announced in so far, the last round of the city challenge competition
June 2018	Shillong selected as the hundredth smart city

Despite the commendable efforts, which included several firsts in Indian cities like the city level challenge, mandatory public participation, and smart technology in cities, the mission also faces critique from many quarters. While reviewing the guidelines mission document, it is evident that the objective of city-building is coupled with the mission delivering on aspirations such as improving socio-economic factors like job creation, education etc. Likewise, sustainability is also loosely thrown into the definition more as a ‘lip-service’ than commitment through policy and planning Criticism on India’s SCM has been aplenty with individual scholars taking aiming at the mission being viewed as a ‘’panacea for all urban ills’’ that could be cured overnight, without sufficient consideration and thought process going into it (Varghese, 2016 p.).

Kumar (2017) questions the real intention of the mission regarding the statement found in the document that the “purpose of the smart cities mission is to drive economic growth and improve the quality of life of people by enabling local area development and harnessing technology, especially technology that leads to smart outcome” (MoUD, 2015, p.6). He criticises that stating the objectives of inclusivity, sustainability and improved quality of life and parallelly targeting to improving economic development, presents as conflicting priorities. Therefore, there is a real danger of economic growth being the primary objective at the expense of inclusivity and sustainability. This is especially relevant as the problems of urban poverty, unemployment, lack of adequate infrastructure and shelter are still to be dealt with in Indian cities. Often when it comes to achieving economic growth through urbanization in Indian cities, it is the urban poor that is displaced and evicted. Kumar (2017) also strongly criticises that the mission document is very vague in the implementation plan of building and maintaining the infrastructure. He considers that budget of INR 100 crores (USD 16.39 million) per city per year, with an equal amount contributed by the state government, is an insignificant amount as the construction of a 2km stretch of road is likely to cost around INR 2 crores (USD 1.43 million). As some states have a more significant number of smart cities allocated than others, it places much stress on the financial capability of the state governments too.

Despite these criticisms which are highly valid in the views presented, a nation-wide city-based competition is a new idea in the Indian context. At the same time, there seems to be an overall sense of urgency in implementing the projects as evident from the timeline. The selection of the 100 cities in the first city challenge was held within a short period of approximately three months. This time is insufficient for activities such as proper formulation of vision for the city, identifying the specific area for development in consultation with the public, identifying key issues and shortcomings in the selected area, devising strategies for area-based and pan-city developments, identifying consultants for the project and services design, preparing the design documents and estimating project costs, and more. Given the scale of activities involved and the inexperience of several cities, especially the smaller cities, in preparing a proposal of this complexity, the time frame allocated was very short. Additionally, the lack of sufficient consultants to work on the project is also evident as in some regions, only a handful of consultants were shortlisted to work. At least during the initial proposal stage, only 37 consultants were working for 88 cities (PTI), 2015). Given the initial proposal approved after selection by the central high-powered committee cannot be altered, it has high significance. It is quite possible that the smaller city governments will be at the mercy of the consultants. However, the real nature of the proposals can only be understood by looking more closely at a sample of cities (see also section 8.4.7). Therefore, to achieve this purpose, the next section, therefore, analyse the smart city proposals of the cities selected in the first round of the city challenge.

6.4 Content analysis of Smart Cities Proposals of the first 20 cities

The first stage of this research involved analysing the proposals submitted by the twenty cities that won the city challenge competition (see Figure 6.10). The proposals were analysed under two segments: area-based development and pan-city development proposals. The smart city challenge document submitted by the cities followed the format issued by the Ministry of Urban Development. The document contains five sections, namely, city profile, area-based proposal, pan-city proposal, implementation plan and financial plan. The document was submitted with a set of annexures, including conceptual drawings detailing out smart city features and self-assessment forms. The proposal had been prepared with the help of consultants shortlisted by the Ministry and involved citizen engagement facilitated by the respective city-level local bodies. The area-based development was the key proposal in the document in which an identified area was proposed to be developed into a 'smart area'. Under this head, the proposal outlined the smart characteristics proposed in relation to the urban form. The content analysis was primarily focussed on this section. The pan-city proposal was principally one proposal that was intended for application throughout the city, and this segment was also analysed for its content to get a picture of the various proposals submitted.

Figure 6. 10: 20 cities that won the first level city challenge

Source: MoUD (2015)

as the latter uses very conservative numbers. Based on this observation, a list of the first selected twenty cities along with it's their rank based on population and classification is identified in table 6.2.

Table 6. 2: Population of the twenty cities

Source: Adapted from United Nations (2018) and Census of India (2011a)

City	Population of urban agglomeration (in thousands) in 2018 from the UN report	Rank based on population	Classification of city
Ahmedabad	7,681,000	3	Tier I
Belagavi	490,045 (2011census data as UN data unavailable)	17	Tier III
Bhopal	2,278,000	11	Tier III
Bhubaneswar	1,100,000	14	Tier II
Chennai	**10,456,000**	**2**	**Tier I**
Coimbatore	**2,641,000**	**10**	**Tier II**
Davanagere	434,971 (2011 census population)	19	Tier III
Guwahati	1,083,000	16	Tier II
Indore	2,822,000	9	Tier II
Jabalpur	1,411,000	14	Tier III
Kakinada	384,182 (2011 census population)	20	Tier III
Kochi	2,858,000	8	Tier II
Ludhiana	1,806,000	13	Tier III
New Delhi Municipal Council	28,514,000	1	Tier I
Pune	6.276,000	5	Tier I
Surat	6,564,000	4	Tier II
Jaipur	3,717,000	6	Tier II
Solapur	1,014,000	17	Tier III
Udaipur	3,068,420 (2011 census population)	7	Tier II
Vishakapatnam	2,076,000	12	Tier II

Content analysis is a method of qualitative analysis that is defined as "a set of methods for analysing the symbolic content of any (written) communication. The basic idea is to reduce the total content of a communication to a set of categories that represent some characteristic of research interest Shannon (2005) Although content analysis is primarily used to analyse the content of novels, newspapers and other forms of media to evaluate the message conveyed, in a planning context, it is also used for evaluating contents of planning codes, zoning codes and other policy documents (Singleton and

Straits, 1999). Babbie (2010) supports this notion and states that content analysis is an unobtrusive form of qualitative research analysis that involves the study of recorded communication by humans that includes books, articles, documents, newspapers, speeches and even television, movies etc. The general method used for content analysis is equivalent to conducting a close-ended questionnaire survey. The steps involve preparing an evaluation protocol that would define categories for analysis that would, in turn, be used for reading the written communication and scored.

The analysis of the proposal documents revealed that the cities had put forward a wide and varied range of proposals that sometimes-used different terminologies for communicating the same design intent. For instance, some cities specified cycle sharing facilities, while some others specified it non-motorised transport as a feature. Therefore, to arrive at a common platform for comparison, similar features were combined. Annexure- D gives an outline of the different proposals by the 20 cities, makes a numerical representation of the joint proposals under area-based development, after combining similar proposals under various sub-heads and Annexure- 3 analyses the pan-city proposals.

The Area-based proposal analysis (see Figure 6.11) revealed that many of the cities had proposed to improve the public realm of the area by improving public open space provision and use. The next most highly specified proposal was encouraging walkability by improving pedestrian facilities within the proposed area. In many proposals, this was also combined with including provisions for a non-motorised form of transport like cycling, providing cycle sharing facilities and e-rickshaws. The other most common proposals included transit-oriented developments (TOD), encouraging mixed-use and density and improving economic activity through tourism and heritage preservation. It is evident from Figure 6.11 that most major %age of the proposal was related to improving the urban realm with a particular focus on open space, walkability and connectivity. There were only a few proposals that identified the use of technology in the area-based development whereas, in the pan-city proposals (Figure 6.12), as guided by the mission document the use of smart technology was highly prevalent. These proposals were mainly focussed on delivering smart transit systems, centralised command centre and e-governance platforms, to name a few.

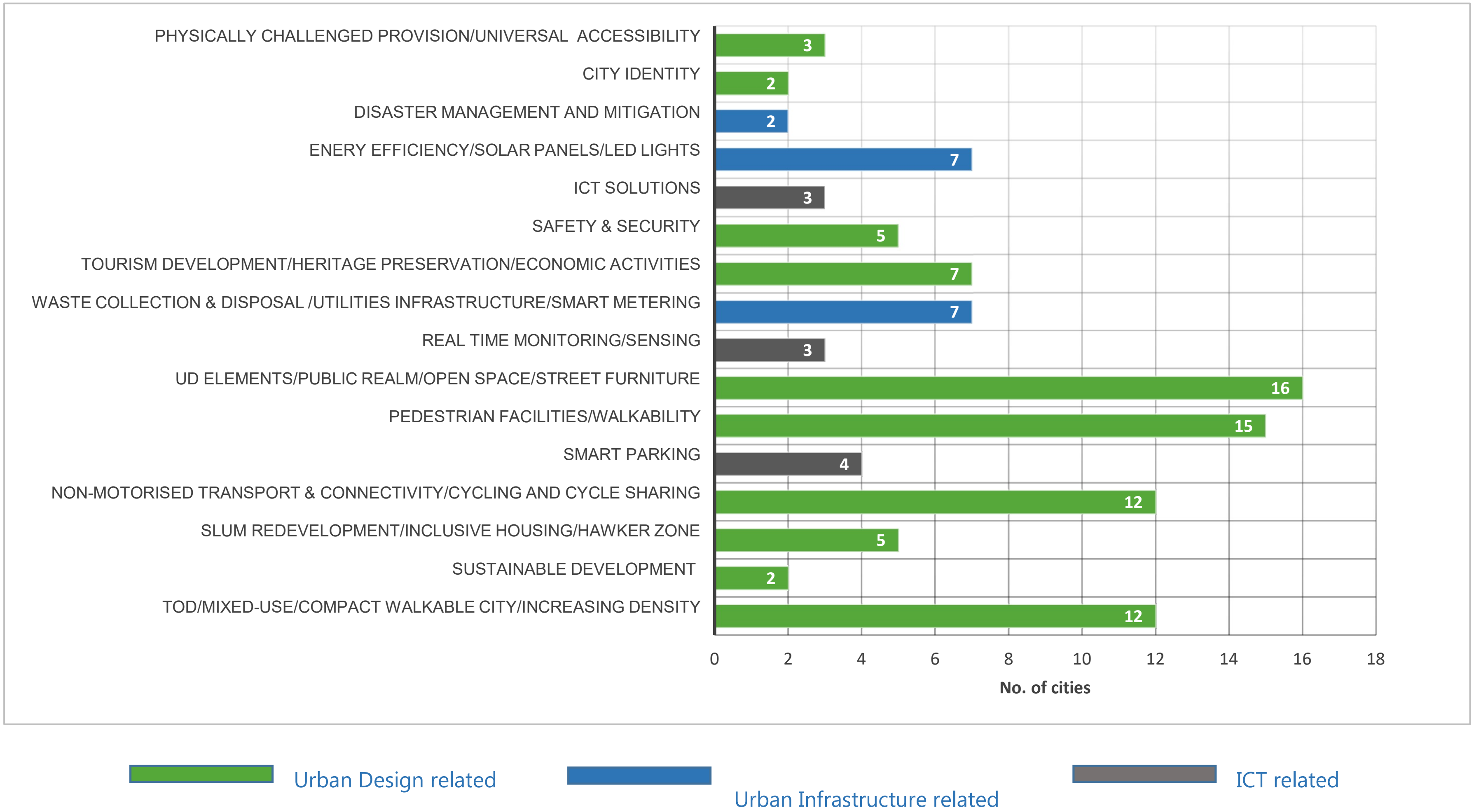

Figure 6.11: Proposals submitted by 20 cities under area-based development

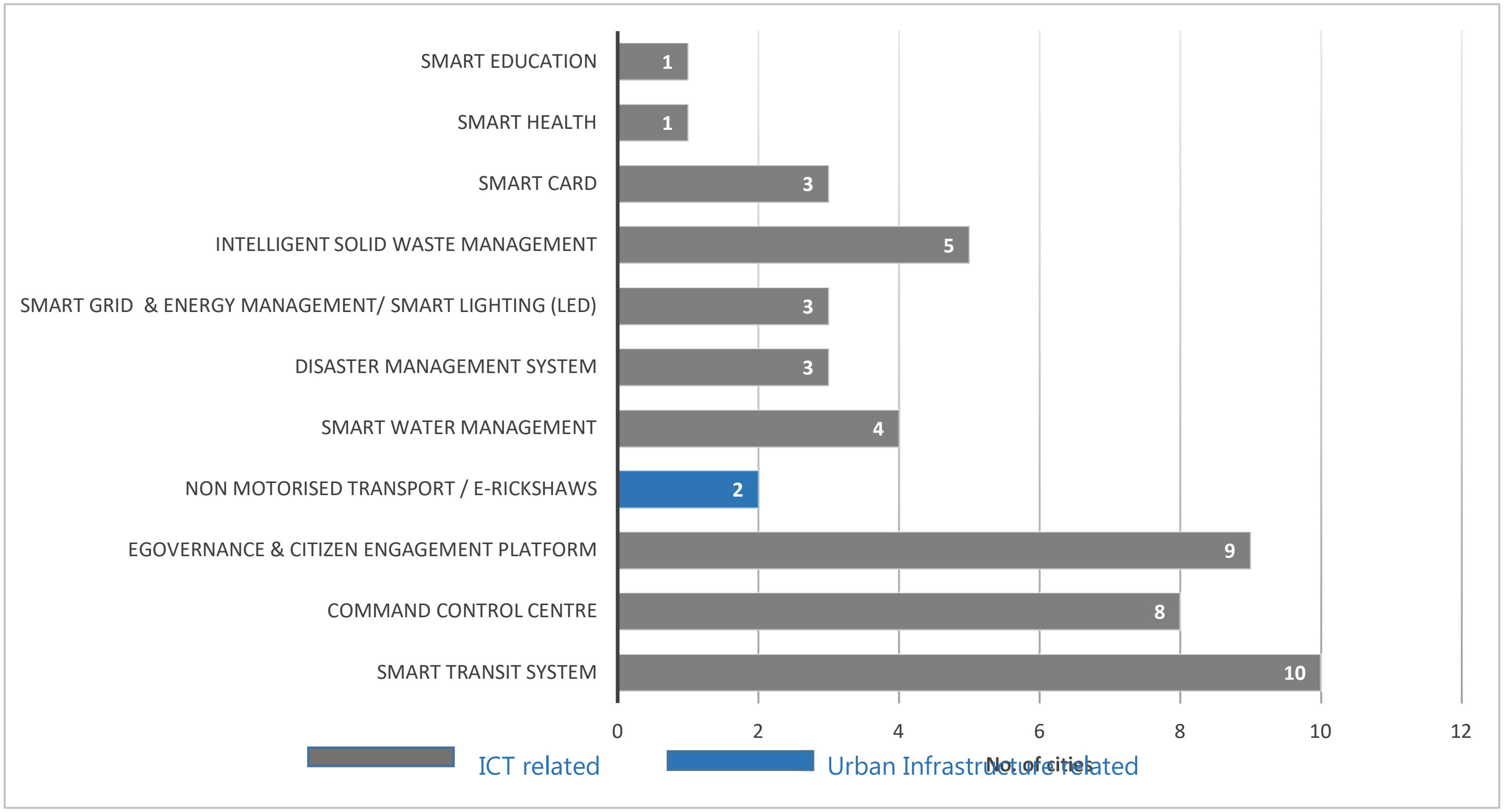

Figure 6.12: Proposals submitted by 20 cities under pan city development

Based on the findings of the content analysis, it is necessary to understand how these proposals would compare when compared with the smart city objectives by other global cities. The analysis of the proposals by twenty cities reveals a wide-ranging list of initiatives that vary significantly between the cities. Even though the sample size of twenty is relatively small, the varying size and population of these cities and distribution of these cities across the country provide a strong basis to gain a substantial understanding of the SCM. Due to the variation and extent of proposals, it is essential to understand how the proposals fit within the already established smart cities parameters. To determine this, the Cohen wheel action areas and indicators are used to highlight the focus area of the twenty cities. Based on the distribution, the smart wheel (see Figure 6.13) is shaded to reflect the focus areas of the sample cities, underlining the areas where there is a lack of action. A few indicators do not fit within the twenty-one areas and therefore listed separately.

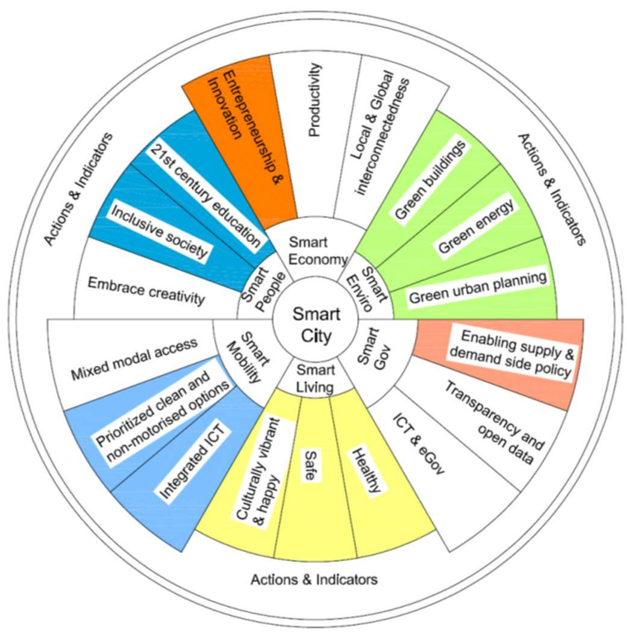

Figure 6. 13: 20 cities that won the first level city challenge

Source: Adapted based on Cohen's smart city wheel model

6.5. Urban design policy

The content analysis clearly revealed a greater emphasis on projects related to urban renewal, retrofitting, development and place-making in India's smart city proposals. This further supports the already purported theory on the relevance of including urban design as an additional dimension within the smart city framework. However, discussions in chapter two highlighted the lack of standardized urban design guidelines and principles in Indian cities, which presents a contradiction. Indian cities, following the national initiative of smart cities development, place a stronger emphasis on urban planning and design-focused projects. This is an interesting scenario as there are no national/state /city level policies or processes in place, specific to urban design. The Urban Regional Development Plans Formulation and Implementation (URDPFI) guidelines (TACPO, 2015) released as two volumes, highlights the role of urban design in some of the areas in the document. Urban design's role is acknowledged in creating streets for better network and connectivity and in the preservation and conservation of heritage cities. The document lists the urban design framework as part of the conceptual framework while preparing local area plans and recognizes the need for an urban design approach at a local contextual level. Also, the document advises urban design approach within the development control rules for standardization for façade, material, height and style controls. Though this is very generic advice to state/local planning agencies to consider this aspect within their planning regulations, it is an evidence of the recognition (though minimal), on the importance of urban design within the national planning agenda for Indian cities.

As evidence, there is a slow and steady acceptance of the role of urban design within the policy framework of urban development in India. This refers to an acknowledgement of the discipline and the role of an urban designer within India's national urban policy framework. Another notable mention is the Model Building Bye-Laws (TACPO, 2016), which mandate the need for an urban designer within the core team of the heritage conservation committee. Both the URDPFI guidelines and the model building byelaws were both released around the same time as the SCM. This is a promising beginning, although, there is a lack of clarity in urban design guidelines at the national level. In the history of the post-independence city-building process in India, the above cases are the first-time urban design requirements are mentioned at least sparsely in the policy documents at the national level.

To understand the level at which urban design policy guidelines are dealt with at the local government level, an online search through city government websites was conducted, which is listed below. In addition to the first twenty cities, development regulation rules for other prominent cities like Mumbai, Kolkata, Bengaluru and Hyderabad were also analysed. The policies or guideline documents are very few and, in most cities, there is a complete absence in this regard, which indicates a lack of awareness and sensitivity towards the topic of urban design. It is possible that the compilation (see Table 6.6) might have missed on policies that are not in the online domain, as some cities do not upload all policies online. However, the city planning departments in at least the major Indian cities that have a good online presence do not have published guidelines on urban design.

Table 6. 6: Urban design policy in Indian cities

Source: Compiled by author

	CITY	PUBLICATION
POLICY	**NEW DELHI**	
	Street Design Guidelines for Equitable distribution of Road Space	Unified Traffic and Transportation Infrastructure (Plg. and Engg.) Centre (UTTIPEC), Delhi Development Authority
		Nov 2009 Nov 2010 (Rev 1)
		http://smartcities.gov.in/upload/uploadfiles/files/StreetGuidelines_DDA.pdf
	Pedestrian Design Guidelines	Unified Traffic and Transportation Infrastructure (Plg. and Engg.) Centre (UTTIPEC) Delhi Development Authority
		Nov 2009
		http://www.uttipec.nic.in/upload/hotlinks/2018/07/5b3b4f9b3b187File215.pdf
	CHENNAI	
	Non-motorised transport policy	Corporation of Chennai
		2014
		http://www.chennaicorporation.gov.in/images/nmt%20tamil.pdf
	PUNE	
	Urban Street Design Guidelines	Pune Municipals Corporation
		2016
		https://smartnet.niua.org/sites/default/files/resources/urban_street_design_guidelines_in_pune.pdf

In this author's experience of practising as an architect in India for around eleven years, she was fortunately exposed to working with the city planning authorities for the cities of Chennai, Bengaluru, Hyderabad, Thiruvananthapuram and Pondicherry, to obtaining planning permissions for architectural projects. In addition to also working on projects in tier-II cities, this author has on at least one architectural project in each of the above capital cities of the respective south Indian states of Tamil Nadu, Karnataka, Andhra Pradesh, Kerala and the territory of Pondicherry. The opportunity to work on these projects enabled me to gain a first-hand understanding of the local planning regulations and requirements so as to facilitate obtaining building permissions. The planning regulations documents for these major cities were mostly Master Plans published with varying levels of details. However, there was a total lack of urban design orientation in these master plans, nor were any other guidelines published by the specific planning departments. The limit to any form of design control in the built environment was primarily to do with height, setback, plot coverage and floor area restrictions. There were a few other minor façade controls like balcony projection limitations, but this is where the controls or guidance ended.

While state governments have an essential role to play in providing an enabling environment through legislation and institutional structure for the city planning process, they have not come up with any urban design direction so far. Therefore, the onus lies on the national government to provide direction in this regard and for the local governments to prepare contextual guidelines in line with the national directive. It is debatable whether India, as a vast, populous, diverse and heterogeneous nation, can have a single, unified urban design approach. However, without a national directive, the process cannot move forward toward establishing a national urban design framework. There are several examples of this approach globally with countries like Australia, New Zealand and the United Kingdom are having national-level urban design policy guidelines. Australia, for instance, has a well-established urban design theoretical framework which is put into practice with successful outcomes. The continued dominance of several Australian cities in global rankings for urban quality of life stands testimony to this viewpoint. Likewise, Australia acknowledges good urban design through annual awards that encourage healthy competition and creates good design culture (Jacquot et al., 2019). Additionally, the policy guidance and support for urban design are available at all three levels of Federal, State and local governments with published guidelines (see Figure 6.14).

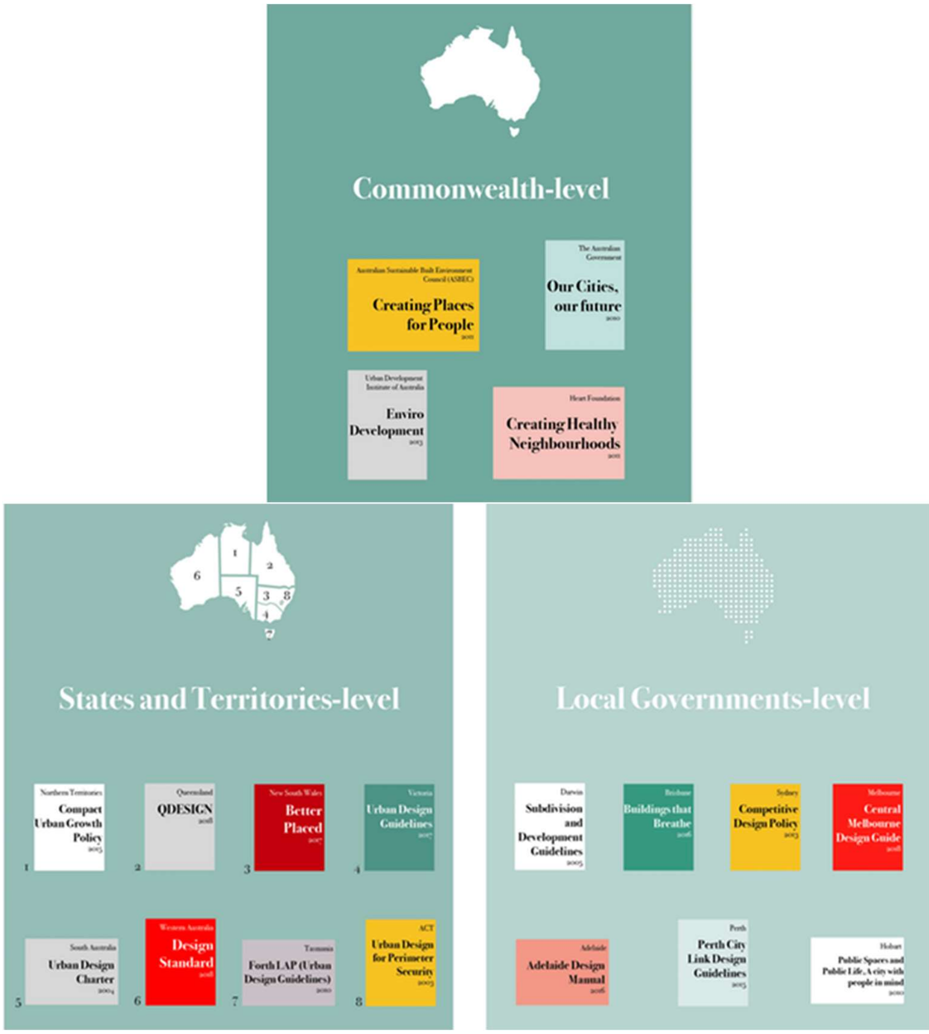

Figure 6. 14: Urban design policy at three levels of government in Australia
Source: Jacquot et al. (2019)

The Urban Design Task Force, established by the then prime minister of Australia in 1994, was instrumental in setting the policy directions for Australia's expanding cities. This was later followed by the Australian Urban design Protocol document by the Federal government called "Creating Places for People" (Australian Government, 2011) which is regarded as a collective commitment to achieve the best urban design outcome in Australian cities. Jointly prepared by government bodies at all levels along with industry and community groups, the guideline gives a broad outline of principles that would promote excellence in design by accentuating the unique characteristics of a location and its community. Australia's Urban design protocol, together with New Zealand's Urban Protocol (Ministry for the Environment, 2005) and UK's National Design Guide (Ministry of Housing Communities and Local Government, 2019) are all excellent examples for India to work towards a national urban design policy.

6.6 Urban Design – the guiding principles

Past research on smart cities has acknowledged only the six key dimensions of Economy, Environment, Living, People, Governance and Mobility. The crucial element of 'place' that ties all these aspects together, especially the design aspects of this 'place' dimension is missing from the discourse. Having established the need for the 'place' component in smart cities, the requirement arises to understand the crucial indicators that contribute to the 'place-based' design dimension. While the analysis of the contribution of urban design towards the six dimensions in smart cities has revealed some key attributes, it also becomes imperative to understand this in a broader context. As evident from the cases of UK, Australia and New Zealand, an urban design framework at the national level policy approach is a proven way towards good city building outcomes. Especially in a smart city where there is a high reliance on 'sensing' rather than creating a 'sense of place'.

One of the methods of developing a national policy is through developing an urban design framework (UDF). The UDF is "a document describing and illustrating how planning and design policies and principles should be implemented in an area where there is a need to control, guide and promote change" (Cowan ,2002p. 12). It is also referred to by other names such as urban design strategy, planning and urban design framework and area development framework. Urban design, in developed countries, is extensively used for creating an excellent urban environment and is highly relevant in the context of city building, image and identity. In Australia, the nationwide urban design protocol is an outcome of the collaboration between industry, government and community. The protocol sets outs its ambition to create liveable and sustainable spaces with excellence in urban design (Australian Government, 2011). Similarly, in the United Kingdom, the Commission for Architecture and Built Environment (CABE) prepared a Councillors Guide to Urban Design guide (CABE, 2003) which identifies the fundamental qualities of successful urban places. It recommends that UDF's are prepared in areas where growth is planned, or changes proposed and essentially explains

-explains ways the development policies will be implemented in that area

-lays out a comprehensive set of design principles for the area

-links strategy to practice

-sets out guidance for development control

In addition to devising an overall national policy for urban design, followed by specific contextual policies at the city level, the case studies also provide evidence on the need for a regulatory framework to ensure enforcement of the policy. As indicated earlier, Indian cities currently do not have any specific guidelines towards urban design, barring the few recent attempts like New Delhi, Pune's street design principles or Chennai's non-motorised transport policy. Pune's policy is well-structured and has covered all elements of the street design, including the road-related, pedestrian-related, cycle-related and footpath related requirements (Pune Municipal Corporation, 2016). Chennai's policy on the other hand mainly covers encouraging non-motorised modes of transport in the city by providing new footpaths where necessary, removing encumbrances along existing footpaths, creating bicycle pathways and other providing other pedestrian amenities to meet the overall objective of reducing motor vehicles on the road for sustainable transport solutions (Corporation of Chennai, 2014). The above two policies, along with New Delhi's, can be acknowledged as a move in the right direction for the individual cities. However, urban design guidelines for roads and footpaths do not address all parameters in the right policy direction. What is needed is a comprehensive policy that would set out the urban design guidelines for the built environment, at the national level is for an Indian smart city.

Mandating urban design, as part of the planning process, can pose its own set of challenges. Design control through the planning mechanism leaves the planning officers within the local or state government with the power to approve or reject a proposal. Especially in an Indian context, this could lead to several issues such as delays in decision making, favouritism due to corruption, vested interests, lack of expertise in the planning department to finalize projects, lack of funds to recruit experts or design professionals and so on. Though these challenges will be hard to deal with, initially could lead to some positive outcomes in the future.

An additional control process is also prevalent in some international cases, namely, design review. Some examples of this design control measure which utilises expert opinion in a detailed view are the Aesthetic Advisory Committee in the Netherlands set up in1922 and the Design Commissions that were set up in American cities in the mid-70s (Punter, 2007). As indicated in chapter three, the system of urban arts commission is prevalent only in New Delhi in India, and no other checks or balances are available in the rest of the cities. Therefore, design review is another approach that needs to be considered for its appropriateness in the Indian context.

Davidson and Arman (2014) strongly advocate the approach by the Sydney city council in Australia to conduct urban design competitions for large scale urban projects. Using Competitive Design Policy (CDP), the city council ensures design excellence in major urban projects. On a comprehensive survey of several stakeholders, the authors found that a majority of the stakeholders agreed that there was much improvement in the quality of projects delivered through this method, though the process was felt to be time-consuming by some stakeholders. A typical Indian city and a city like Sydney or Melbourne are indeed at the two ends of the spectrum with one focussing on getting the essential ingredients of city living right and the other striving to achieve the best possible outcome for its city and citizens. In Indian cities, architectural design competitions for individual buildings are quite common. However, when it comes to the design of public spaces, the process of design competitions is rare, as most city corporations would consider appointing an architect based on the lowest fee quoted for the project. Design review and public consultations are often not conducted.

However, these approaches may be useful for successful urban space outcomes for future cities. Given that the Indian SCM is likely to contribute greatly to transform the urban landscape in the cities, developing a national policy guideline/framework will ensure appropriate practices for the changing built environment. This will also set the tone and act as a guiding light to future Indian cities to develop world-class public spaces.

6.7 Conclusion

This chapter has delved deeper into the SCM by looking at the development of new smart cities in India and their contribution to the current mission. The analysis of twenty smart cities proposals highlights the extensive focus on city redevelopment strategies as the primary option undertaken by most cities. Though several cities have also opted for retrofitting as part of area-based development, redevelopment along with greenfield developments are higher in the list of proposals. Given the scale of urban interventions proposed in these cities where the impact of the development could affect a minimum of 50 acres to more than 500 acres, it validates the need for an urban design framework in Indian cities. The analysis of the outcomes within the context of the Cohen wheel is a useful exercise to understand if the proposals are in line with the smart cities thinking adopted globally. The next section will look in more in detail at two case studies of Chennai and Coimbatore, to understand the extent to which the smart city proposals are addressing critical challenges in the city

CHAPTER 7

CASE STUDY: QUALITY OF URBAN LIFE

7.1 Introduction

Content analysis in chapter six revealed the high priority given by most Indian cities towards urban regeneration and renewal strategies, under the SCM umbrella. Given this focus, research on India's policy landscape revealed the lack of or only minimal efforts towards urban design policy, in a handful of cities. Majority of the cities including the major metropolitan cities like Mumbai, Kolkata, Bengaluru and Hyderabad, in addition to numerous tier-II Indian cities do not appear to place enough emphasis on the design aspect of the public realm. Therefore, a more in-depth understanding of the barriers and opportunities towards smart cities, including establishing an urban design perspective, is required. This analysis would contribute to addressing research question three of this thesis. It is relevant to understand the contribution of the SCM to overcoming the challenges in Indian cities. In this connection, the case study of Chennai and Coimbatore cities, both located in the south Indian state of Tamil Nadu, is conducted. A two-step approach is adopted to analyse these case studies. Firstly, chapter seven investigates the contextual background of both cities, along with an analysis of the urban quality of the two cities. The second step is covered in chapter eight, which involves interview data analysis, to establish barriers and challenges in smart cities is constituted from smart city proposal documents and visual observation (primary data) of the study area in both cities, along with published literature on the cities (secondary data).

7.2 Overview of Tamil Nadu

The state of Tamil Nadu which means “Land of Tamil people or the language”, lies in the south Indian peninsula, shares its borders with the states of Andhra Pradesh, Karnataka, Kerala and the union territory of Puducherry (also known as Pondicherry). The Eastern Ghats mountain ranges bind the state in the north, Bay of Bengal in the East, Nilgiris, Annamalai Hills and Kerala in the west, and by the Indian Ocean in the South. Tamil Nadu was India's eleventh largest state in terms of area and the seventh most populous state as of 2012. The state is the third-highest GDP contributor to the nation. Often referred to as the manufacturing powerhouse of India assisted by the availability of a highly skilled workforce. Also, the strategic location of ports and good road infrastructure results in the state's significant contribution towards automobile, electrical and textile manufacturing sectors of India (Austrade, 2015). Chennai (formerly Madras) is the administrative capital of the state. The official language, spoken by the majority in the state is Tamil, while speakers of other Indian languages, especially Telugu, Kannada and Malayalam are also present as a minority. The state is known for south Indian temple architecture, centred on Hinduism. The UNESCO World heritage-listed Shore temple at Mahabalipuram near Chennai and Brihadeeshwara Temple in Thanjavur (see Figure 7.1) are excellent examples of Dravidian Architecture of Tamil Nadu.


Figure 7. 1: Shore Temple (L) and Brihadeeshwara Temple (R)
Photo credit: Carl Finkbeiner and Jupiter Images Corporation (2019)

Tamil Nadu is the seventh most populous state in India and with a population of 72.1 million in 2011. It is also the most urbanised state in India with 48.40 per cent of its population living in the urban areas of 721 statutory towns (TACPO, 2015) considering geographical area and total population, excluding the union territories and the smaller state of Goa. The economic and strategic advantages, along with a high level of skill availability and literacy, make Tamil Nadu one of the highly progressive states in India. Naturally, the state has one of the highest distributions of SCM proposal cities (see Annexure -3).

The two cities of Chennai and Coimbatore in Tamil Nadu were selected for the case study in this thesis. There are a few reasons behind the choice of these two cities, particularly within the state of Tamil Nadu. Chennai and Coimbatore have two distinct population scales and therefore provides a good basis for comparison. As discussed in section 3.3.2, some classifications the cities are categorised as tier-I and tier-II cities respectively. While in another classification Chennai is regarded as Metropolitan-II level city and Coimbatore, as one of the forty-five cities with a population between one to five million, is classified as Metropolitan-I cities (TACPO, 2015). Secondly, the two cities won the first round of the cities challenge in the SCM, along with eighteen other cities. The timing of the first-round city challenge results coincided with the start of this thesis. Thirdly, the study on the current nature of cities in a relatively progressive and urbanised Indian state could reveal the realistic positioning of Indian cities, compared to cities in less developed states. Therefore, the case studies selected helped in understanding the gap and planning steps for future developments. Lastly, Tamil Nadu is the birth state of the researcher, and therefore familiarity with the local language and settings is useful to the research context. Based on the above arguments, the case study of Chennai and Coimbatore is selected discussed in the following sections. In addition to Chennai and Coimbatore, the other cities enlisted for smart city projects in Tamil Nadu are Tiruchirapalli, Tirunelveli, Dindigul, Thanjavur, Tirupur, Salem, Vellore, Madurai, Erode and Tuticorin (see Figure 7.2).

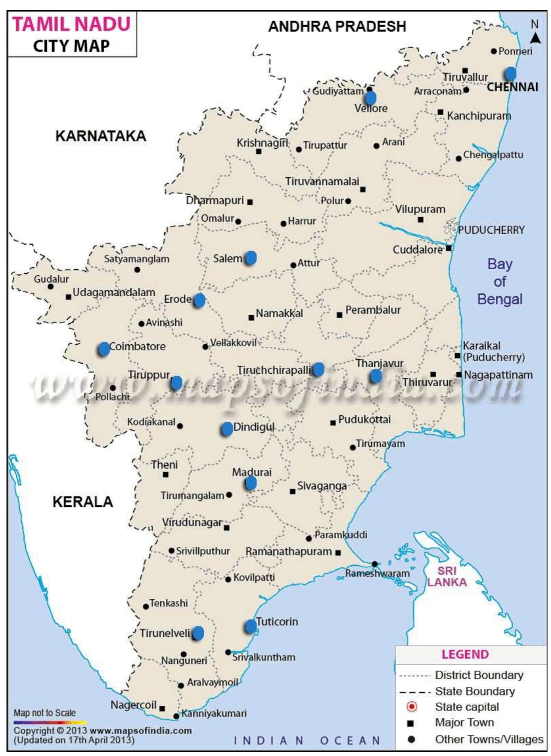

Figure 7. 2: Map of proposed smart cities in Tamil Nadu

Source: Maps of India website

7.3 Case Study - Chennai

Chennai is the largest city in Southern India and the administrative capital of the state of Tamil Nadu, one of the twenty-eight states in India. Under the British regime, the city was the capital of the Madras Presidency that constituted a significant part of the Indian Peninsula. The coastal city was known by the name Madras until 1996 when the state government officially changed it to Chennai, a derivation from the name Chennapattinam that was used before British rule. The Greater Chennai Corporation website gives a more detailed overview of the history of the city right through its colonial days (Greater Chennai Corporation, 2008). Chennai is the fourth largest metropolitan city in India following Delhi, Mumbai and Kolkata, with a population of 8.65 million, which constitute 25 % of the state's urban population (Census of India, 2011a). Though the population growth of Chennai has seen an upward trajectory since independence, it did not grow at the same pace as the other three metro cities. As of 2016, except Chennai, the three other cities have crossed the 10 million mark in the population count (Singh, 2016). It is also owing to the reason the city's boundary was not revised in line with the expanding peri-urban growth, a strategy followed by other Indian cities. In early 2018, the state government issued a draft notification to expand the metropolitan area from the current 1189 sq.km to 8878 sq.km. The proposed change was opposed by a number of small villages in the peri-urban areas, and therefore the decision to expand is under review (Kabirdoss, 2019). The revised footprint of the city would have meant a revision to the census population. An in-depth study of Chennai may, therefore, be helpful to establish possible future directions for other Indian megacities.

The smart city proposal for Chennai involves area-based development of Thyagaraya Nagar (T.Nagar) in the central part of the city. The pan-city initiatives proposed in the SCM involves a number of ICT based interventions for the entire city. T. Nagar is one of the busiest commercial districts not only in Chennai but at a regional scale. The smart city proposals in T. Nagar will be discussed in section 7.3.3. Before analysing the smart city proposal, it is important to understand the nature of the study area. The next section will look at geographical features and urban character of Chennai city as a whole, to provide a contextual basis for the smart city proposals.

7.3.1 Geographical setting and Urban character

Chennai Metropolis is located on the Coromandel coast in southern India and has a flat coastal plain topography. Three rivers viz. Kosasthalaiyar, Cooum and Adyar pass through Chennai Metropolitan Area. These rivers flow their way to the Bay of Bengal Sea on the east. Buckingham Canal, a human-made canal, is another prominent waterway which runs north-south through this Metropolis. Sholavaram Lake, Red Hills Lake and Chembarambakkam Lake are the three large lakes that supply water to the city. As Chennai lies close to the equator, it is hot and humid for most of the year. Highest temperature attained the summer in May-June is usually about 40°C. The relatively coldest time of the year is early January when the temperature is around 20°C and the predominant wind direction is from South East to North West. The city is a major transportation hub for road, rail, air and sea transport connecting major inland cities as well as help with overseas trade. It is also one of the major educational centres in India with several universities, colleges and research institutions. It is an important destination for medical treatment within India and with several super-specialty hospitals, positions Chennai as a sought-after metropolis in the South Asian region. The city, in the last few decades, has transformed into one of the leading IT hubs in India from being a predominantly commercial and manufacturing base (Krishnamurthy and Desouza, 2015).

While the Greater Chennai Corporation is the city's governing body, the Chennai Metropolitan Development Authority (CMDA) is the nodal planning authority for the city, that directly works under the state government. CMDA was constituted in 1974 under the Town and Country Planning Act of 1971. The Chennai Metropolitan Area (CMA) currently extends up to 1189 sq.km. and comprises of eight municipalities, 11 town panchayats and 179 villages in 10 panchayat unions. The CMDA's jurisdiction extends beyond the corporation's boundary, which is currently 476 sq.km after the expansion in 2018 from the original area of 176 sq.km (see Figure 7.3). As indicated in the previous section, the CMA is also under review. Some of the main functions of CMDA include carrying out a survey of CMA jurisdiction, preparing Master plan, detailed development plans and new town development plans area, preparing land use plan, development approval etc. (Chennai Metropolitan Development Authority, 2008).

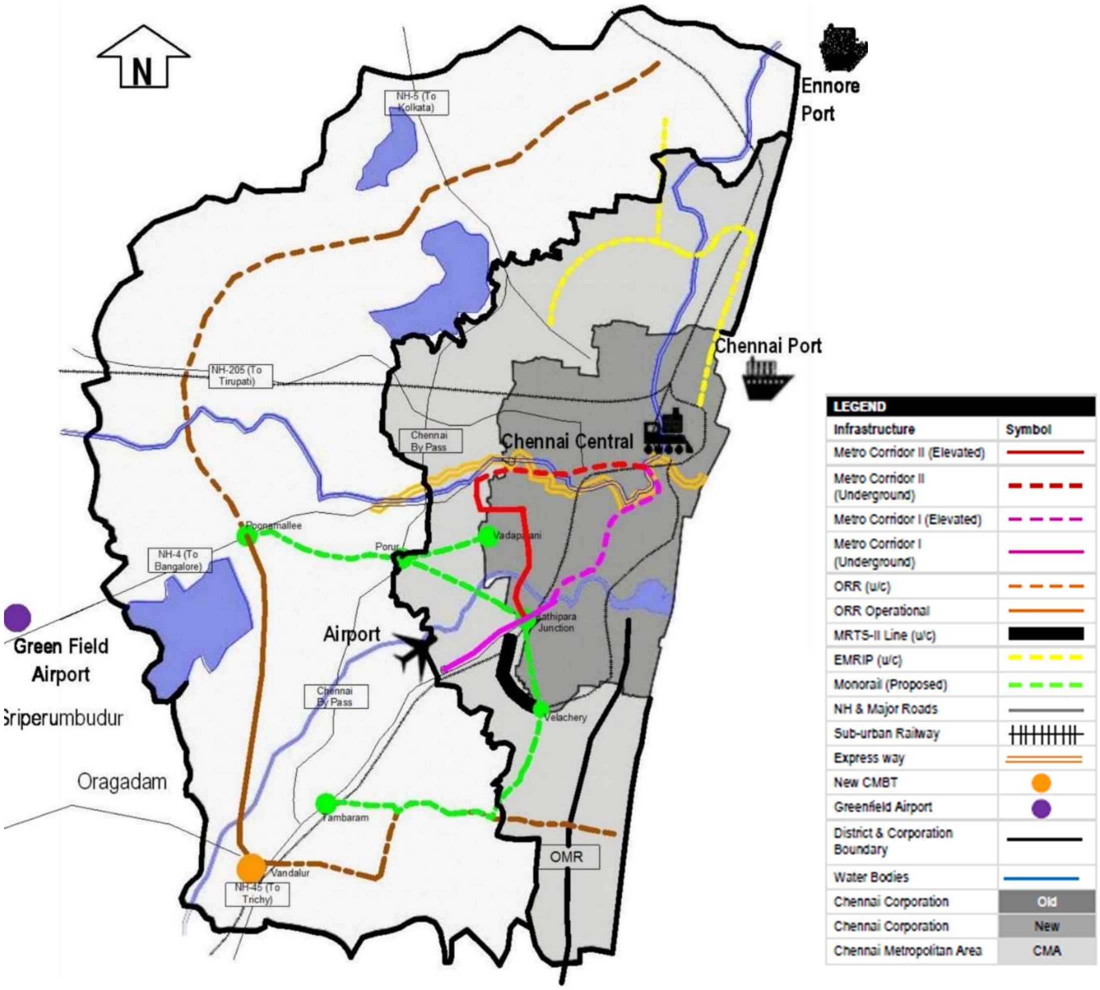

Figure 7. 3: Chennai Metropolitan Area

Source: Chennai Smart city proposal-downloaded from www.smartcities.gov.in

Due to the various invasions over its history, Chennai has a very heterogenous built character, spread between Hindu temple architecture to Indo-Saracenic style to the British neoclassical colonial-era buildings and post-modern architecture. The CMDA (2008) website presents a brief outline of the city's history of urban growth. It is believed that the Portuguese were the first settlers around the 16th century. However, the majority of the city development happened post-British colonisation. In 1600 AD the city was formed from few settlements, scattered over a large area. Each settlement grew around the nucleus of a religious institution, especially of a temple and had its history. Chennai has been occupying an essential position in the southern region ever since the East India Company in the 17th century transformed it from a fishing hamlet to an administrative and military centre for South India. The evolution of Chennai from 1633 to the continued land-use change up to 1971 can be seen from the below image (see Figure 7.4). Similar to the case of Madurai discussed in section 3.3.1 (refer to Figure 3.6), one of the earliest areas that developed in Chennai was Mylapore that formed around the Kapaleeswarar temple. Other temples that have historical significance in the growth of the city are Parthasarathy temple. Kalikambal temple, Marundeeswarar temple, to name a few. As summed up by Trouillet (2017), Hindu temples in South India played a crucial part in influencing the land use and shaped the urban morphology of its locality. The temples were both symbolic identities to its surrounding settlements, commercial and tourist centres and promoted or restricted economic activities through spatial restrictions on the land they owned.

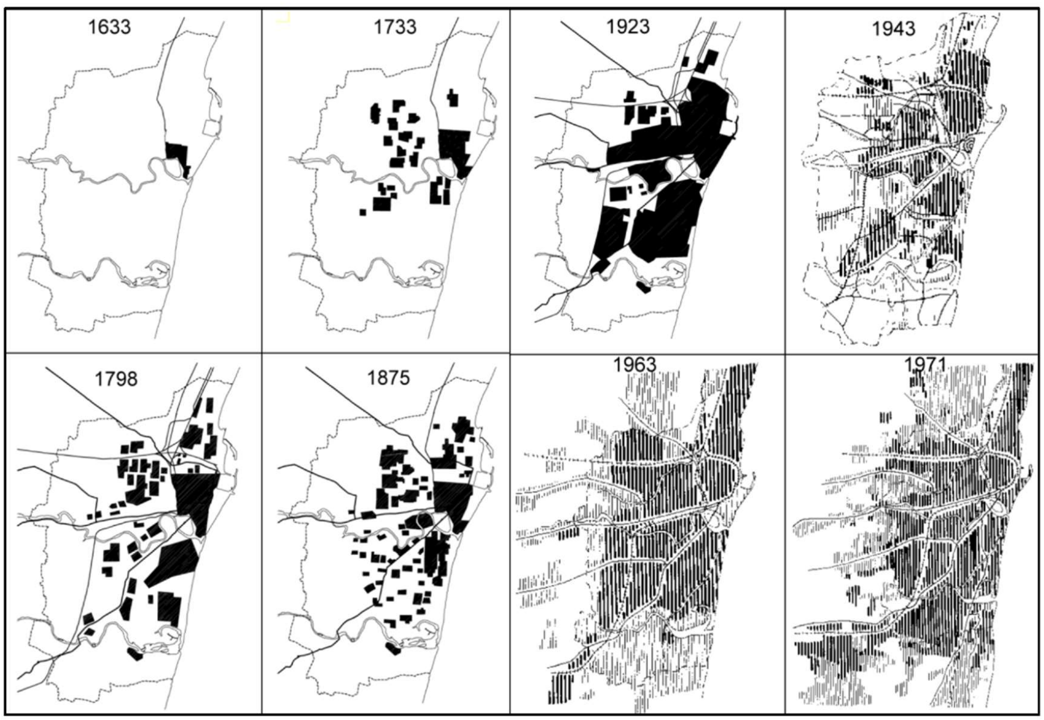

Figure 7.4: Growth of Chennai since 1633 -1971

Source: CMDA,2008

The planning history of Chennai city dates back to 1920 when the Madras Town Planning Act was enacted. Though the town planning act was in place as early as 1920, the first master plan for Chennai was prepared only in the year 1975; also, few Town Planning Schemes were prepared (CMDA, 2013). Chennai has had a long history of planning, yet zoning and building by-laws are still among the primary tools of modern city planning practice in Chennai (Jothilakshmy, 2012). Master plans serve as a guide for other public agencies to prepare sector-based plans. The second master plan for Chennai prepared in 2008, highlights a vision of making Chennai as one of the best liveable cities in India by 2026, with a high quality of life and a sustainable environment. However, the planning policies and master plan do not reflect on how to accomplish this vision. The master plan also does not reflect how the urban form of Chennai city has transformed and information on how climate, landform, built urban fabric, existing physical and social infrastructure services in place, etc., were taken into consideration in the preparation of master plans. From the evidence presented, the growth of Chennai city, post-independence has been shaped by different planning schemes and policies, two master plans and development regulations framed by the Development Authority. The formal planning policy for Chennai city started with the introduction of general town planning scheme in 1957. After several plans in between, it has progressed to the second master plan in 2008 (see Figure 7.5), formulated with land-use zoning and development regulations as the regulatory mechanism for the growth of the city. The spatial strategy and land use planning of the master plan follow zoning and development regulations based on two-dimensional plans.

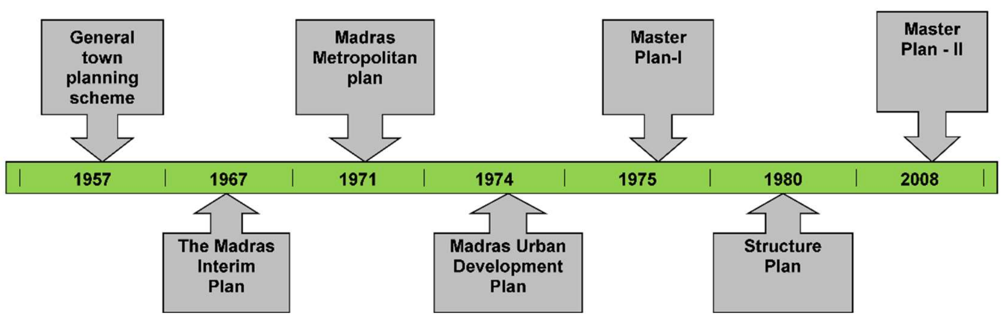

Figure 7. 5: Timeline of Chennai city planning regulations

Source: Compiled by Author from policy documents

Chennai has a multi-nuclei city model without a centrally located business district. Instead, Chennai has several micro districts, namely Anna Salai and George Town were the principal CBD, with Nungambakkam, Purasawalkam, Mylapore, Egmore and T. Nagar (Thyagaraya Nagar) developing into regional commercial districts in the 1990s. Suburbs like Adyar in the south-east and Annanagar in the north-west became regional commercial sub-centres. T. Nagar, originally a residential suburb developed into a major centre for clothing and jewellery market due to its location, public transport availability and accessibility (Karthigeyan, 2016). Other districts such as the newly emerged Old Mahabalipuram Road (OMR) along with Ambattur and the Grand

Southern Trunk (GST) road are emerging growth corridors of the city that are regarded as the peripheral business districts (PBD) of the city (see Figure 7.6). Majority of the city has a low to medium rise-built form (see Figure 7.7) due to the planning limitations imposed by CMDA, which were relaxed after the Second Master Plan.

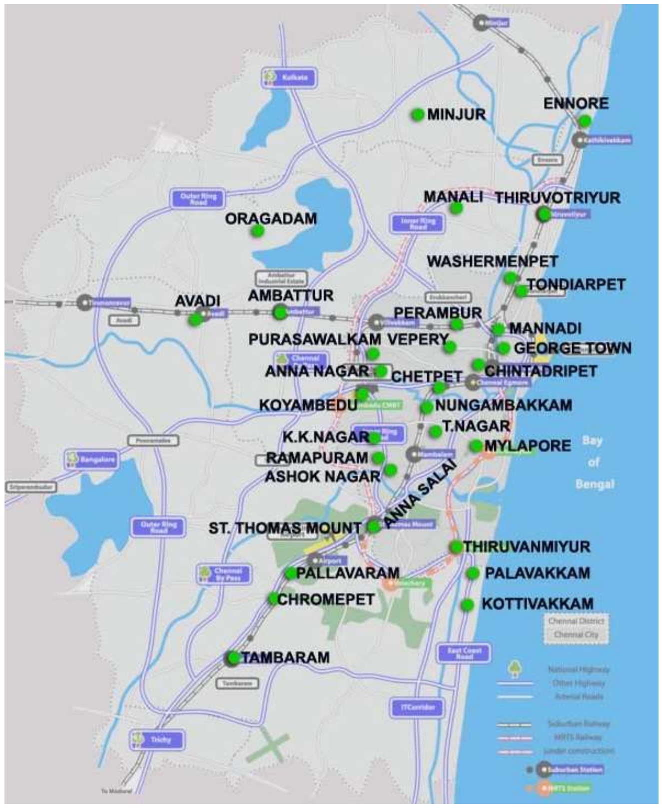

Figure 7. 6: Chennai's multi-nuclei development model

Source: Adapted from Karthigeyan (2016)

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Figure 7. 7: Chennai aerial view overlooking the Chepauk cricket stadium near Chintadripet

Source: The Hindu Net Desk (2018)

The city's urban and economic development has centred around the development of "sector-specific corridors" with heavily invested road infrastructure (Dupont and Dhanalakshmi, 2013). Some of those include the Oragadam industrial corridor along the west of the city and IT corridor in South Chennai along OMR (see Figure 7.6). Kennedy (2015) calls Chennai's ÍT Corridor 'project as a hybrid mega project that combines characteristics of old and new megaprojects. The classifications of old and new being based on the funding modalities, with 'old' megaprojects, are state-initiated, state-financed and mostly have a single project outcome while the 'new' mega projects that are more diverse and involves creating mixed-use spaces for the public benefit. The IT Corridor project though is primarily constructing a state-initiated 18km long six-lane IT expressway, the route and positioning of the corridor aimed at strengthening links between three large IT parks and further encouraged several such private IT campuses at various points along the road. Following this brief overview of the urban character of the cityscape and planning practices, the next section looks into major planning challenges facing the city.

7.3.2 Major planning challenges

The major planning challenges facing Chennai that impedes not just a sustainable growth for the city and also its intent to become a smart city are highlighted in this section.

Urbanization and master plan mechanism

Chennai's urban expansion over the last couple of decades has been in the southward direction, as it is bound on the east by the Bay of Bengal and the boundary of the adjacent Andhra Pradesh limiting in the north. Thus, the city started to grow predominantly in the south and to a limited extent towards the west. The southbound Old Mahabalipuram Road (OMR) [4] corridor has been the spine of this growth, expanding the city boundary towards the UNESCO World Heritage-listed coastal site of Mahabalipuram, which is 58 km away. The East Coast Road (ECR) runs parallel to the OMR along the coastline and is part of the urban growth corridor. The OMR, along

[4] Old Mahabalipuram Road (commonly referred as OMR) was renamed as Rajiv Gandhi Salai by the state government in 2007 and the six-lane road was declared as IT Highway. However, it is more commonly referred by its old name OMR)

with the scenic ECR, were primarily tourist roads. The IT boom that resulted in the stretch getting promoted as the IT highway resulted in several former villages and fishing hamlets getting absorbed into the city's sprawl (see Figure 7.8). This partly unplanned and sporadic growth spurt caused several ecological and environmental challenges to the administrative machinery (Narain et al., 2014).

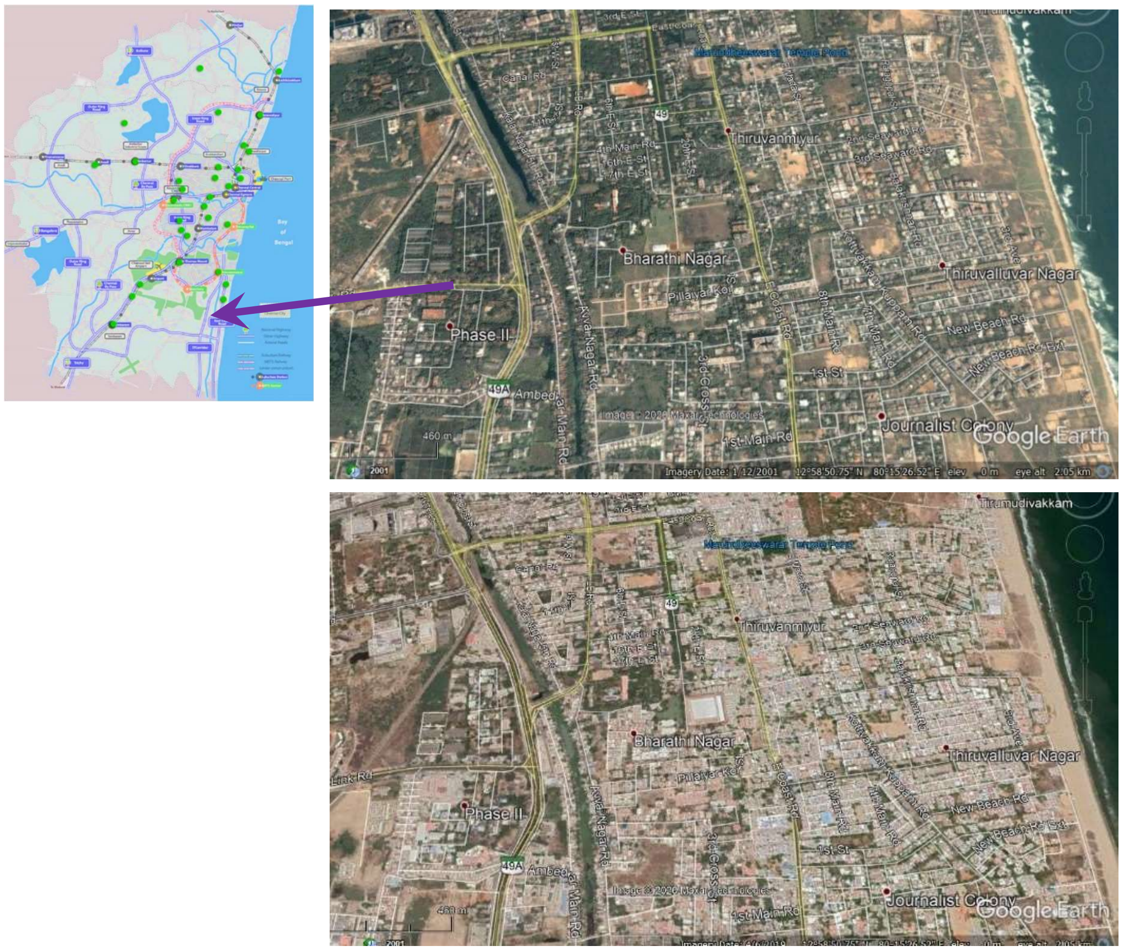


Figure 7. 8: Historical densification along the Old Mahabalipuram Road (2000 to 2019)
Source: Google Earth

Tamil Nadu was the first among Indian states to initiate a specific IT policy in 1997. Different parastatal agencies promoted the IT corridor megaproject; some of the developments were part of different state government ministries. Also, the stretch has several facilities owned by India's leading IT companies such as Infosys, Tata Consultancy Services (TCS) along with several other companies. Some of these major companies have multiple facilities along the IT corridor, which is either wholly-owned, leased from real estate companies or within the campuses developed by real estate developers (Kennedy, 2013). The lack of planning or rather a structured planning vision for the peri-urban areas of the city can be best explained using the case of Rajiv Gandhi Salai (erstwhile Old Mahabalipuram road) or popularly known as the IT Corridor along the southern stretch of the city. The development that spurred on either side of the corridor can be seen visually. Developments of such scale are expected with population rise. However, the basic infrastructure facilities like sewage and water connection (The Times of India, 2019a) are not available in several sections of the new developments, as they rely on septic tanks.

Provision of Green infrastructure

Chennai's water body related issues are multi-fold, frequent droughts, poor storage management, and planning practices, all contribute to a variety of issues. When it comes to open areas Sasidharan and Prosperi (2011),categorise Chennai's open spaces as a triad of blue (water bodies), green (parklands) and brown (wetland) spaces. Chennai has around 230 parks, 102 tanks, along with the three river systems and human-made Buckingham canal. These water bodies were once supplying fresh water to the city. The non-perennial nature of the river systems meant that the city's water supply is dependent on three primary irrigation storage tanks and one small reservoir, all of which meets full capacity only during the monsoon season (Janakarajan et al., 2007).The city, therefore suffers from frequent drought periods, making it one of the water scarcest cities in India. Ramesh (2015) calls Chennai's water situation as unique and refers to it as the city built on water. Despite water sources, it is belted with chronic water shortages due to high reliance on seasonal rainfall. It is a common sight during peak summer to find private water trucks supplying groundwater procured from neighbouring villages to be sold at wealthy neighbourhoods and gated communities. As Gupta (2019) reports, the water scarcity in 2019 caused international headlines on the city running out of the water, after poor rainfall and extreme heat conditions dried up all sources .

The second aspect of water scarcity is the improper storage facilities caused by poor planning. Shyamsundar (2016) brings to notice the lack of precise specifications on the extent of prohibitions in the 15m buffer between the water edge and a development. Around the same time as the Climate change conference COP21 was held in Paris in

2015, Chennai was inundated with flooding, affecting millions of people. The floods were not a one-off incident as a cyclone-prone region in India, Chennai is wrought with floods few times in a decade, with other instances of severe flooding due to heavy rainfall has been witnessed in 2005 and 2008 (Dorairaj, 2009). The development control rules of CMDA do not specify this clearly and likewise nor does the Directorate of Town and Country Planning rules. The Flood Plain Zoning (FPZ) regulations set by the Central Water Commission of the Government of India in 1975, required land use in flood plains to be regulated in all Indian cities, to determine the level of development activities in those areas. However, this is yet to be implemented in the planning scheme of CMDA. A development buffer zone of 15m was planned to be implemented by CMDA, which is not regularised consistently. Also, time and again the city's drainage system is constantly tested during cyclones and heavy rainfall episodes and have been found wanting due to various reasons such as sediment formation at river mouths, choking of the drains due to solid waste and construction waste debris (see Figure 7.9 L), insufficient design capacity of the drains, poor quality work (Figure 7.9 R), incomplete network of stormwater drains and finally illegal encroachments of semi-permanent structures along the river banks greatly diminish the carrying capacity.

Figure 7. 9: (L) Dilapidated state of a waterway in T. Nagar

(R) Construction of a stormwater drain (mason assisted by his wife)

Source: Author (2017)

To assess the impact of the floods, the Government of India entrusted Comptroller and Auditor General of India (CAG), (2017) to evaluate the incident. The CAG report indicated that most of the devastation was human-made due to poor land and waterways management. It was found that the area of water bodies in the city declined from 100.98 sq.km to 91.31 sq.km. Different lakes spread across the city were converted to new residential neighbourhoods, Several prominent private property developers were permitted by CMDA to obtain building approval on these lands by the reclassification of the water body area as primary or mixed residential zones The revenue department in charge of issuing the title deed, sub-divided the plots and issued the deeds, though they fell within the Adyar river zone (Shivakumar, 2018). The lack of stronger development controls and defined edges of water line as protected areas is the reason for this issue.

Pallikaranai wetland in the south-eastern part of the city is facing a similar predicament. The saltwater marshland lost its supply of seawater from the Bay of Bengal following the construction of Buckingham Canal in 1876. As a result of rainwater inflow, it became a freshwater swamp that supported a wide variety of aquatic and terrestrial species and several plants. Besides, the 31 tanks along the North, South and West orientation feeds surplus water into the tank, thereby maintaining the hydrological balance of the surrounding catchment areas. Due to illegal encroachments, development activities, dumping of solid waste by the city corporation and burning of toxic wastes, the marshland is on the verge of extinction (see Figure 7.10). The original extent of the marshland is documented by the Survey of India in 1972 as 5500 hectares and is currently estimated as 600 hectares (Surya, 2016) in 2016. This is also due to allowing construction of about 500 meters on either side of the Old Mahabalipuram Road (OMR) road or the popularly known as the IT corridor by the CMDA. Chennai, among other Indian cities, has a unique estuarine ecosystem, with the Adyar creek is part of this ecosystem. Large scale constructions at its mouth have shrunk the estuary. Mogappair lake, which has completely vanished and Ambattur tanks are other water bodies, the beds of which has given rise to extensive residential suburbs.

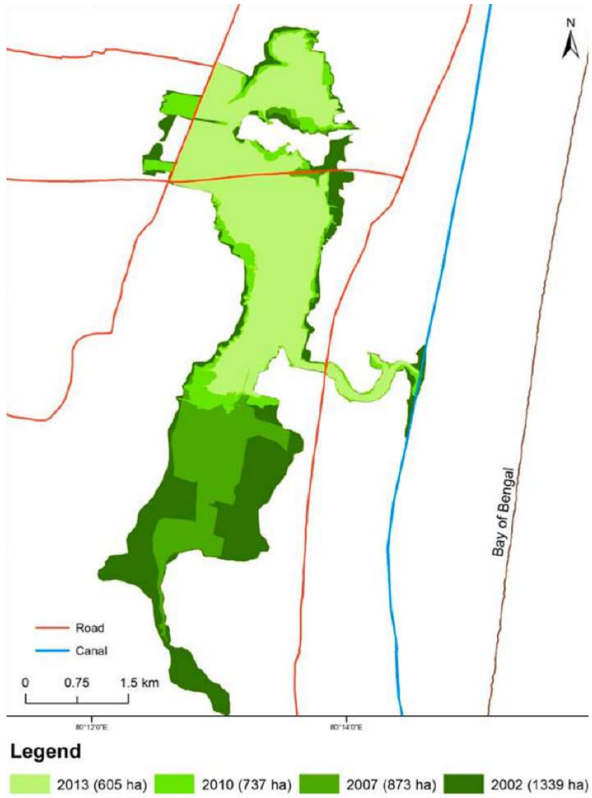


Figure 7. 10: Changes to Pallikaranai marshland catchment between 2002 – 2013

Source: Surya (2016)

Provision of Open Space

Open areas in a city are not just relevant for maintaining a pleasant ambience but also for the recreational purposes of the community. The World Health Organization mandates a minimum of 9 sqm per capita of open green space in any urban setting (WHO, 2010). On analysing of the land use of the city for the 176 sq.km. Land area. Vaani and Anand (2018) find that the built-up area accounts to 73 %, while water bodies are 4 % of the total land area, the open area in the city accounts to a meagre 7 % and is only slightly healthy due to the presence of 9 % agricultural area (see Figure:7.11). The authors found that with consideration of 2001 Census results for Chennai population, the open space available was only 2.8 sqm per capita. Given that there has been a two-fold rise in population since then, and the expansion of city limits in 2011, there has been no drastic improvement in the percentage of open space. The research found that in most suburbs, the built-up area ranged between 61 % to 83 %. The Mambalam taluk under which the T. Nagar area-based development comes under has a 91 % built-up area and a meagre 2 % of open area. Similarly, Egmore, another major centre has 89 % built-up area and 2 % open area.

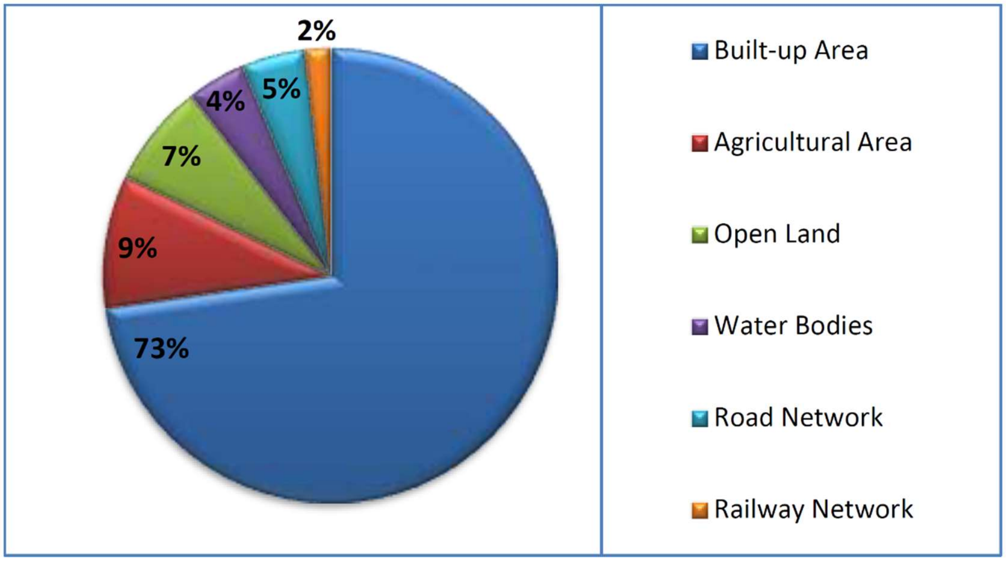


Figure 7. 11: Land use classification in Chennai

Source: Vaani and Anand (2018)

According to the second Master Plan (CMDA, 2013) for the Chennai Metropolitan Area up to 2026, the open space and recreation land use in 2006 was 0.19%, and it is expected to increase up to 0.38%, considering the extension of the city boundary. Given the metropolitan population to be 12.6 million (126 lakhs) by 2026. Based on the above data, the open space provision works out to 0.80 square metres per person. This is way below the minimum urban green space requirement of 9 square metres per person, recommended by the World Health Organisation. Comparing both the pieces of evidence, it is clear lack of open area, and green space in the city is a huge concern, especially in the established suburbs in the core of the city. While the extent of open areas is far less than the recommended values, the quality of the open space is often also found to be limited (see Figure 7.12). The illustration shows a playground in T. Nagar for community use. The provisions in the playground were less than the bare minimum as the basic play equipment were basic and very dilapidated. There is no delineation of the playing surface except a concrete court (not seen in the picture) and an incomplete pedestrian walkway. As the playground is popular with kids from surrounding schools, it is highly used, yet illegal parking of private vehicles (autorickshaws) can be seen in the image, at the far end of the playground. The footpath outside the play area also was in a state of disrepair. These findings indicate that provision for open space and green spaces is insufficient in Chennai. This is a crucial consideration, especially in Indian cities with dense living environments. Unlike western countries with suburban residential neighbourhoods with backyard gardens addressing the green space provisions, most high-density Indian cities do not have personal green spaces.

Figure 7. 12 (L): A public playground in T. Nagar (R) Footpath outside the playground
Source: Author (2017)

Traffic congestion and parking

Given the rapid expansion of the city's extents, Chennai is highly reliant on private vehicles. Chennai has a relatively stable public transport network primarily comprising of bus system run by the Metropolitan Transport Corporation (MTC) of Chennai. This is supported by the suburban rail network operated by the 'Southern Railway', one of the 18 zones of the Indian Railways. Besides, an elevated metropolitan railway network (MRTS) for some parts of the city was operationalised in 1995. However, the situation of traffic congestion remains unaltered, if not been increasing in the city. To overcome this situation, the Government of Tamil Nadu in partnership with the Government of India started implementing the Chennai Metro Rail Project (CMRL) in 2015. The project which is under partial operations is currently in its second phase of construction. However, the success of phase 1 is still under scrutiny as the patronage is not up to the projected levels due to the fair price being very high in comparison to the MTC (Selvakumar et al., 2018). Even though Chennai has good bus network, suburban trains and the newly added metro, the number of private vehicles are increasing (see Figure 7.13) causing severe traffic congestion (The Times of India, 2019b).

Sen Gupta (2015) showed that along with Coimbatore, Chennai has a high vehicle density in the state with an excess of 200 vehicles per kilometre of road length. Nationwide Chennai has as high as 2093 vehicles on the road per kilometre, which is the highest in the country. Though the Delhi region has the highest vehicle concentration in the country, due to its 1800 km of road length, Chennai is the densest. Therefore, these factors contribute to the increasing traffic congestion in the city. Additionally, insufficient parking spaces the state of the environment in Tamil Nadu report (ENVIS Centre, 2017) identifies that parking charges in Chennai are approximately 50 times lower than in most developed countries. Discouraging haphazard parking (see Figure 7.14) by enforcing fines and increasing parking charges in tourist and shopping destinations is recommended as a strategy for reducing road traffic in those areas.

Figure 7. 13: Traffic congestion in Chennai

Source: (Deccan Chronicle, 2019)

Figure 7. 13: Two-wheelers blocking the entrance to Panagal park in T. Nagar, Chennai

Source: Author (2017)

Pollution

The Tamil Nadu Pollution Control Board (TNPCB) is in charge of monitoring the air quality in the major cities of the state, under the National Air Quality Monitoring Programme (NAMP). The state has international airports in Chennai, Madurai, Coimbatore and Trichy, with the first three cities also having domestic airports. In a study conducted in 2015 to measure the greenhouse gas emissions by various Indian cities, Chennai had the highest emission of 4.79 tonnes of CO2 equivalent per capita. Likewise, Chennai had the highest emission of 2.55 tonnes CO2 equivalent per lakh rupees of GDP (Ramachandra et al., 2015). The result is possibly on the higher side due to the current expanded size of the metropolitan area. However, it still indicates the city’s impact on climate change due to its high level of GHG emissions. The western coast of India enjoys relatively milder temperatures and therefore has less reliance on cooling means that contribute to the carbon dioxide emissions. The cities on the east coast have much higher temperatures and therefore tend to have higher emission levels. Chennai has the highest level of electricity consumption among the cities, due to its high reliance on it for cooling purposes. Chennai has the highest number of annual cooling degree days among the cities while Bengaluru has the lowest. (Ahmad et al., 2015)

As a consequence of greater reliance on private vehicles, traffic congestion owing to the sprawling nature of the city, air pollution has been a rising concern in Chennai. Similar to many other Indian cities (see Figure 7.15), which records a very high and unhealthy air quality even at early morning hours, without peak hour traffic. Barring few cities, most cities identified in the map has air pollution range of very unhealthy to hazardous levels. One of the ways to arrest this situation is to develop a unified transportation policy. This would allow for addressing the gaps in the network, for increasing access to public transport and reduce car dependency. Also, noise pollution is not discussed at the same level as air pollution even though the major metropolitan cities in India are among the noisiest in the world. This is due to high levels of industrialisation, overcrowding, population growth, traffic density in addition to the widespread use of loudspeakers and bursting crackers during festivals and weddings. The level of noise generated in Chennai typically is in the higher end of the spectrum as it varies between 52.7dB to 119.4 dB (Zope et al., 2018), which could cause ear damage.

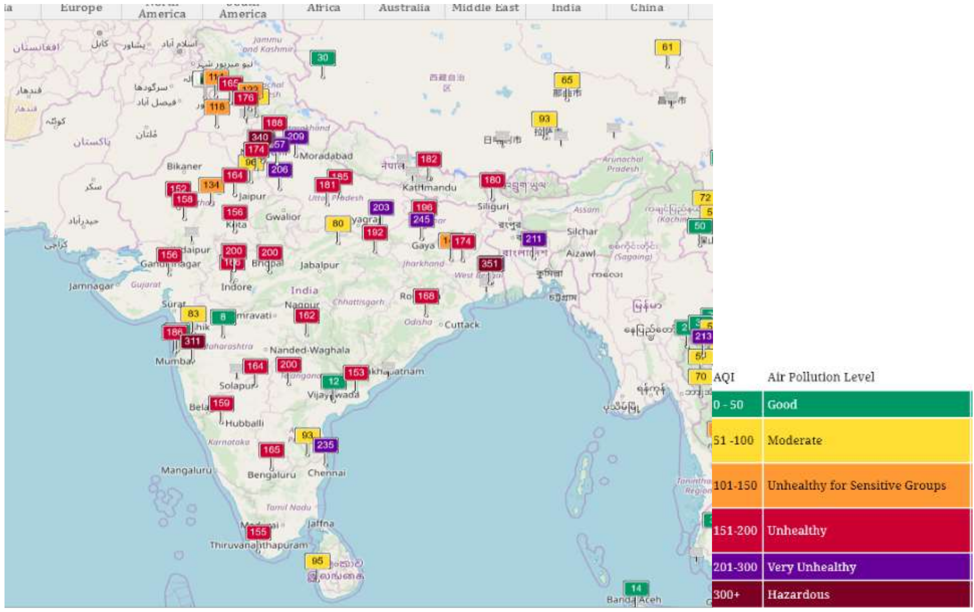


Figure 7. 15: Air quality measurement in India (09/01/2019 @ 6.30 IST)

Source: The World Air Quality Project (2019)

Solid waste disposal

Waste segregation and disposal is another major issue in the city. The sanitary workers in the city segregate the recycled waste, and beyond that, there is no processing of solid waste generated. The waste is disposed of as landfilling in Kodungaiyur, serving the city's north and Perungudi, which is adjacent to the Pallikaranai marshland serving the city's south side. Chennai accounts for 70 per cent of the total stock of solid waste generated within the state. Additionally, Chennai also generates the highest quantity of plastic waste and electronic waste compared to other parts of the state. However, though the Municipal Solid Waste Rules of 2000 states that organic waste needs to be segregated and disposed of in a separate landfill, it is not practised. Due to the high concentration of industries, Tuticorin, Coimbatore and Sriperumbudur in Chennai have the highest levels of industrial waste generated (ENVIS Centre, 2017).Waste segregation and disposal, though not related to urban planning or design , is crucial for a healthy and clean environment and also could drastically improve or reduce the quality perceived. It is, therefore, a massive challenge to the image of the space. In T Nagar, for instance, many streets had street-level waste collection bins projecting out into the road area (see Figure 7.16), obstructing the traffic flow for both vehicles and pedestrians.

Figure 7. 16: Garbage collection bin at a street in T. Nagar, Chennai
Source: Author (2017)

The planning challenges for Chennai are multi-faceted and have a huge impact on the city's progress to becoming a smart city. The planning challenges gives the premises for understanding the smart city proposals in a better light. Some aspects like traffic congestion, air pollution and solid waste management, may not appear directly related to urban planning and design. However, they emerge out of planning failures like poor land-use practices and transport infrastructure planning. Also, these challenges have an enormous impact on determining the overall quality of life in a city.

7.3.3 Proposed Smart City changes

The suburb was formed in the early twentieth century as a result of a planning act of 1920 and was named after Sir Pitti Theagaraya Chetty, a prominent citizen The neighbourhood is in the heart of the city and is the busiest shopping district that serves not just Chennai but also neighbouring districts. The traffic becomes more intense during festival days and the wedding season as it is highly sought after place to buy clothes and jewellery. Tripathy (2018) identifies that T. Nagar does not fit within the general city planning rule of moving from chaos to order. The congested suburb is linked by two flyovers, the South Usman Road flyover begins near the T. Nagar bus terminus and connects with the neighbouring Mahalingapuram, while North Usman Road flyover commences at the central Panagal Park and ends at the Kodambakkam High road junction, another busy street in the city. Though these flyovers were built around the 2008/09 period, the efficacy of these in reducing traffic is questionable as the pedestrian access on already narrow roads had to be removed to accommodate the flyovers. The city corporation's plan to connect the two flyovers to improve the conditions resulted in a huge public out lash that made the corporation to withdraw its plans (Chandrababu, 2015). The reduced or non-existent sidewalks, narrow roads and contest for space between residents, shoppers and hawkers are a constant flashpoint in the suburb.

T. Nagar has vendors catering a wide variety of requirements from fresh flowers, home appliances, clothes for all price ranges, imitation jewellery to gold and diamond jewellery, utensils and vessels etc. In addition to the established organisations, several street vendors display their wares on the sidewalks, on the pushcarts, under the flyover and also occupy any other space available. These makeshift hawkers sometimes use the telephone poles, railings and even parked cars to display toys and clothes. These marginal spaces not just cater to the lower end of society but people from all walks of life. The sidewalks also often become places for two-wheeler parking for customers who visit, as most shops do not have separate parking or offer only limited parking. For people visiting T. Nagar buying from these vendors after intense bargaining is part of the shopping experience of the place (Tripathy, 2018).

T. Nagar was selected under the area-based development model of the SCM. The mission document submitted by the Chennai corporation identifies a number of key issues in the suburb. First among them is traffic congestion, unorganized parking, poor solid waste and stormwater management facilities, absence of wastewater recycling facilities, lack of last-mile connectivity, pollution, safe routes for pedestrians and absence of renewable energy. The improvisations proposed for the suburb is listed below and the schematic diagram by Chennai smart city is presented thereafter (see Figure 7.17).

- *Water supply- system integration, online billing collection with apps, smart metering, water conservation like saving fixtures*
- *Sewage system - choking and overflow sensor monitoring*
- *Stormwater management - sensor-based measurement, ICT for disaster management, a sensor for the weather forecast, rainfall and flooding recording, surveillance system for alerting citizens*

- *Solid waste management - RFID identification system for traceability in waste collection, transportation. Composting, pay as you throw, compost for green roof, waste collection on call*
- *Electricity- sensor-based LED street light system*
- *IT connectivity- Wi-Fi hotspots, video surveillance, digital signage and billboards, e-governance, utility integration including GIS conversion*
- *Smart parking system based on occupancy with real-time monitoring, e-wallet, smart signalling, Multi-level car parking*
- *Smart cycle sharing system*
- *ICT for payment options and integrate information using smart apps for information/ maps, tourist maps, passenger real-time information*
- *Pedestrianization and limiting vehicular access in areas like T. Nagar, managed with smart sensors and using bollards*

The pan-city proposals for the whole of Chennai included five projects that had embedded ICT, as listed below

- *establishing a non-motorised transport network using an intelligent traffic management system,*
- *cycle sharing with a smart card,*
- *parking management using parking sensor, specialised app locator and mobile payment options*
- *water management using sensor-based water level monitoring, flood alert system*
- *smart water system with online registration for water and sewerage connection, online/mobile/app-based grievance reporting and payments*

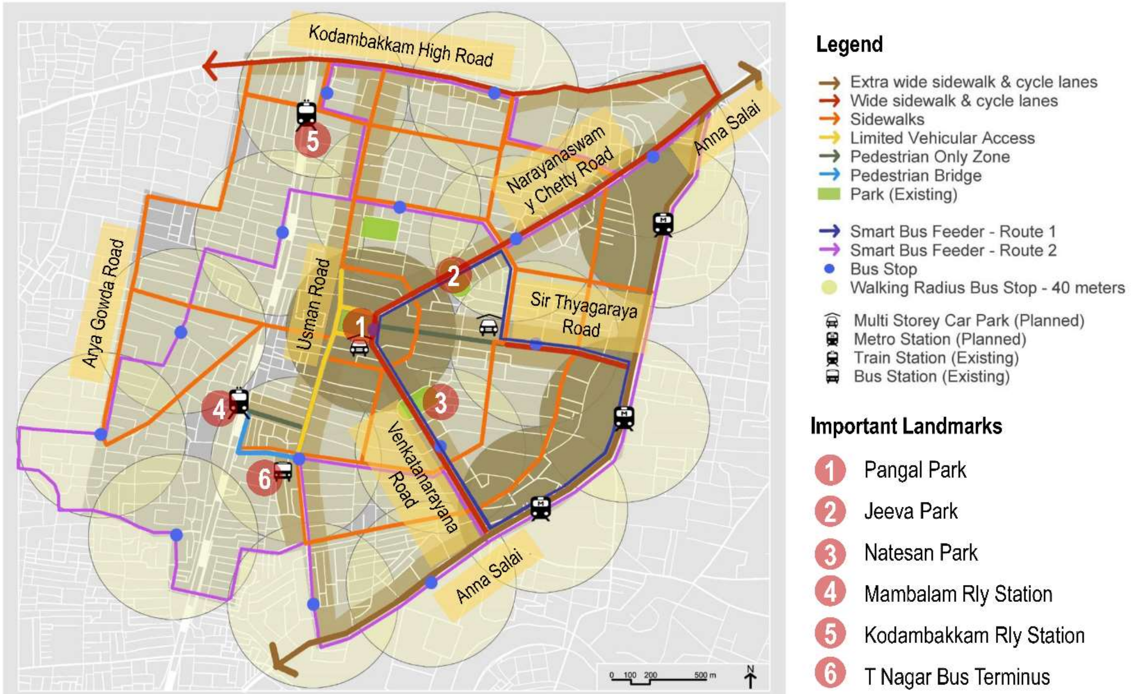


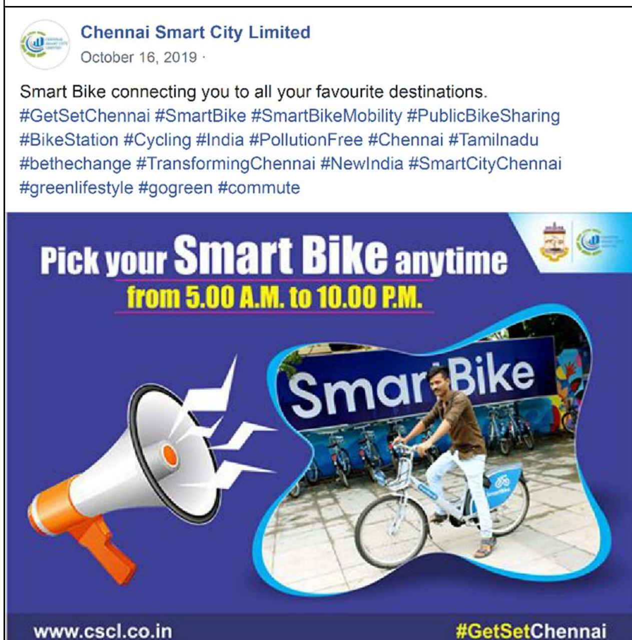
Figure 7. 17: Map showing proposed area-based proposals for T Nagar, Chennai

Source: Chennai Smart city proposal-downloaded from www.smartcities.gov.in

Following the selection of Chennai in the first-round city challenge, there was a delay in instituting the Special Purpose Vehicle (SPV) due to political uncertainty at the state level (see section 8.4.1). Post this, and several projects were carried out in Chennai's mission. It is difficult to adjudge the efficacy of the projects. due to the ongoing nature of the projects, The Facebook page of Chennai Smart City Limited (CSCL) along with the website (www.cscl.in) provides regular updates on the projects, with the former posting more regularly. Few of the completed is illustrated as Figure 7.18 (a to d). It is evident from the projects that the projects have focused on improving the urbanscape of T. Nagar, though on a limited scale. The projects have tried to address the issues of inclusivity, minimising air pollution, improving non-motorised transport options through cycling and walkability.

Sensory park for children of varying abilities in Santhome, Chennai

Vertical gardens in G.N.Chetty road, T.Nagar



Smart bike in various locations in Chennai

Pedestrian Plaza in T.Nagar

Figure 7. 18: Completed smart city projects in T.Nagar, Chennai

Source: Chennai smart city limited Facebook page

7.3.4 Analysis of urban design quality

The section 7.3.2 of this research gave a contextual background of Chennai's planning challenges, followed by section 7.3.3 outlining the smart city proposals and the current status of the projects. This section will analyse T. Nagar on the urban design qualities identified in chapter six (section 6.6), on Chennai. The central theme of research question three is identifying the barriers and challenges for smart city implementation in Indian cities. With urban design being a central dimension, the urban form, spatial patterns and physical characteristics of Chennai, in particular, T. Nagar is herewith analysed. Three stands out qualities can be observed in a typical city street in India. The *casualness* or informality in the use of space; the *contest* for space between competing users; and the visible *contrast* or inequality even at the street level, based on the affluence of the user group. Analysis of the quality of urban areas will consider these three themes.

Mixed-use

The city's layout, along with its accessibility to the central districts, has a considerable impact on the traffic levels. Likewise, the provision of mixed-use and its proximity to the main thoroughfares (Adams, 2014) or transportation networks also contribute to the quality of life. In Chennai, mixed-use was an intrinsic component in the pre-colonial period. The town planning policies imparted by the British rulers (see section 3.3.1) set out the land use zoning patterns in the city. This led to the segregation of industries to the north of the city and prime residential areas developed in the southern and central-west parts of the city. At a neighbourhood level, mixed-use is still prominent in Chennai as in most Indian cities. T. Nagar, initially developed as a residential area, slowly transformed into a mixed-use offering variety of land use, due to its central location in the city. The suburb has good schools, business establishments, and dedicated commercial streets, bringing in people from all around the city and the state. As discussed in section 7.3.3, the variety and diversity of shopping choices offered by the suburb, makes it a one-stop destination for the locals, especially during festival season (see Figure 7.19). The mixed-use developments bring in vitality, diversity of use and inclusivity in the neighbourhood. However, in the case of T. Nagar, its diversity brings a lot of people to flow from other parts of the city, causing severe traffic congestion.

Figure 7. 19: Ranganathan street shopping lane on a quiet day (L) and Usman road shopping street (R) in T. Nagar

Source: Author (2017)

As evident from the above case of T. Nagar, mixed-use development is well prevalent in the Indian context. The arrangement of spaces with neighbourhood level corner shops (see Figure 7.20) serving the local community and creating a walkable environment is part of most Chennai suburbs. In recent years, several master-planned communities as self-contained developments have also sprung in some parts of the city, with residential, office, schools and entertainment facilities provided within the same complex.

Figure 7. 20: (L) A residential main street in T. Nagar with eateries and small shops (R) A typical neighborhood corner shop in Anna Nagar, Chennai

Source: Author (2017)

Sense of place

Chennai is both a historical and traditional city. The physical setting of the city, the ancient religious structures, the heritage buildings from the pre-independence era, along with modern and post-modern buildings, all provide a strong sense of place in several neighbourhoods in Chennai. The multi-nuclei nature of the city was instrumental in creating places with distinct quality in the city. The dominant blue space for the city is the land along the coastline, Marina Beach, which is the most significant open space in the city and gives the city its distinctness. The Marina promenade as a public realm is a well sought-after place in the city, especially during the summer months, flocked by people to enjoy the more refreshing evening sea breezes. Along the beachfront is the service road and green areas acting as a buffer between the city's main arterial road and the beach itself. The green belt, as part of the buffer, has several statues of historical and political leaders and is often a point of contention for some sections of the society. The streetscape is low to medium rise with most along the Marina is dotted by educational institutions, heritage government buildings and public institutions that stand testament to the colonial days (see Figure 7.21).

Figure 7. 21: Marina Beach frontage development
Source: Aiyappan (2017)

One of the first projects that undertook public open space development is part of the Singara Chennai "city beautification scheme" project, which was instrumental in developing the Marina beach promenade by providing several public amenities like walking tracks, public toilets, etc. In addition to the beach, the city has a number of cultural facilities like concert halls, stadiums and some famous Dravidian style temples. Places of worship are strong place markers in most Indian cities, with temples or small roadside shrines can be seen in most streets, contributing to the identity of that place. These facilities interspersed around the city lends a distinct character to different localities of the city. T. Nagar, the study area, is distinct for its shopping experience, in which even the crowd, noise and traffic congestion all becomes part of the experience and lends the place its distinct character

Legibility

The distinctness and historical character of several neighbourhoods in Chennai lends a unique sense of place to the city. However, the legibility of the urban spaces is not always uniform across the cityscape. In T. Nagar, for instance, the main thoroughfares are relatively legible. Figure 7.22.a shows one of the main intersections in the suburb that connecting the suburb with the northern suburbs and Anna Salai, a main arterial road along the east. The intersection with a roundabout (not visible in the illustration), close to a four-star category hotel is clearly well-organised in terms of signages, pedestrian crossing, and traffic flow also has clear visibility of all elements in the street. Similarly, the illustration 7.22 b shows another main street Sir Thyagaraya Road in T. Nagar. The space shown has clear segregation of spaces based on usage like walking, waiting area for the bus and is also well-shaded. The signpost adjacent to the pedestrian pathway indicates that it is a no hawker zone. Contrastingly, a similar clarity is not there in some other streets of the suburb, (see Figure 7.22 c). There is no clear distinction between footpaths, road crossing and small commercial establishments. *Casualness* in the use of space *contest* for space between the hawker and pedestrian and also between .the pedestrian and motorist can be sensed.

Figure 7. 22 a: Legible streets

Source: Author (2017)

Figure 7. 22 b: Legible streets

Source: Author (2017)

Figure 7. 22 c: Lack of distinctive public realm

Source: Author (2017)

Adaptability

Adaptability is a concept intrinsic to Indian society. The term 'Jugaad' in the Hindi language roughly translates to 'inventive hack using limited resources' or 'make do', is a peculiar quality commonly found in the Indian society (Koch, 2018). The 'make do' attitude often transfers itself into adaptive use of public space, not necessarily by design. Chennai is home to numerous heritage building, and there are very few buildings that have gone through an adaptive transformation. More than the adaptability of spaces by design, it is the people who use the space in a variety of ways (see Figure 7.23 a,b,c). Given the high-density neighbourhoods and sometimes meagre setbacks, people often regard the street spaces as an extension of their private property. At the city level, for the first time, the pedestrian plaza in T. Nagar has included informal spaces for pop-up music shows and children's play area along the pathways.

Figure 7. 23a: Adaptable street use – storing construction materials

Source: Author (2017)

Figure 7. 23b: Adaptable street use – a pop-up flower shops outside a temple

Source: Author (2017)

Figure 7. 23c: Adaptable street use – a mobile laundry and cobbler shop

Source: Author (2017)

Compactness

Compact cities are found to be more productive, innovative, use low energy, emit lower greenhouse gases and deliver public services economically and as a result, enhance the health and well-being of its citizens. Therefore, when making plans for urban expansion in cities, it is essential to understand all the forces that shape the space in order to achieve compactness in the urban form. Angel et al., (2018), in their analysis, found that the compactness of a city is most affected by its topography rather than other aspects such as city size, density, income etc. Chennai topographically has a relatively flat terrain, that is conducive to a compact form. However, population growth, rural to urban migration and illegal constructions in the peri-urban areas led to the slow and steady expansion of the city's footprint.

While analysing the spatial pattern of land development in Chennai for the period between 2001-2011, Ramachandra et al. (2015) conclude that there has been a high level of sprawl in the peri-urban regions of the city. The outer boundaries of the city are also characterised by clumped growth nodes with a core. This transformation has significantly impacted the disappearance of agricultural and forest belts. While performing a prediction scenario analysis for Chennai for the year 2026, Ramachandra et al. (2015) believe that the rate of urbanisation to increase from 1.46 % to roughly 18.5 % . As a consequence, a considerable reduction in the vegetation is expected from 70 % to 48 %. The period after 1923, which signifies the beginning of the colonial rule started the densification of the city core and post-independence (1947), the city grew exponentially and started extending beyond the boundaries (see Figure 7.24) This unchecked sprawl goes against the compact city form highly advocated by many researchers (Burchfield et al., 2006). The present-day polycentric nature of the city is partly due to the planned distribution of activity nodes and partly due to organic growth. The First Master Plan and the second master plan prepared by the CMDA envisioned that in the fifty years between 1976 to 2016, the appropriate increase in the built-up area of the city to be 330.58 sq.km. However, satellite mapping of the city over 37 years reveals the actual increase as 450.26 sq.km, which indicates the extent of unauthorised developments along the peripheral edges of the city boundary.

Figure 7. 24: Urban growth of residential areas near Chennai airport between 2000 (top) and 2019 (bottom)
Source: Google Earth

Public realm

The lack of consideration or complete ignorance on the public space in Indian cities is a reflection of the failure to understand the value these spaces impart into the urban life, which often cannot be directly quantified. Kumaran and Swaminathan (2014) note the complete disregard for the public realm in Chennai by the planners, policymakers and the local government. While analysing at the development control regulations of Chennai metropolitan area presented as the second master plan for the period till 2026, in addition to the development control rules like zoning parameters, set back requirements, site coverage and height restrictions, there is no specific inclusions on design control and improving the overall visual interest of the city. Any other specific discussion on the design of buildings is mentioned in Annexure -1 of the regulations (CMDA, 2013) under the coastal regulation zone rules which identifies that “the design and construction of buildings shall be consistent with the surrounding landscape and local architectural style" (p. 88,90 and 91). In addition to this under the special rules section for the conservation of heritage buildings, it is indicated that care should be taken to make any repairs, additions or alterations based on specific applicable religious codes and should be in sync with the design and aesthetics of the existing structure (p.132) (Chennai Metropolitan Development Authority (CMDA, 2013). The above were the only sections in the Master plan that had some information on the desired quality of the public realm.

The lack of any design guidelines for the elements on the street, leave the decision to the respective service provider. Simple details like the kerb size /shape, material finish for a footpath, traffic island design, positioning of service requirements like poles, electric boxes and transformers etc., are carried out without a standard set of design drawings applicable to the whole city. As a result of the disorganization, the quality of the public realm is greatly spoilt. The building shown in Figure 7.25 is one of the premium music halls named Vani Mahal, located in T. Nagar. The presence of the transformer competes with the façade, and the arrangement of the various elements in the street is not conducive to creating a visually good place.

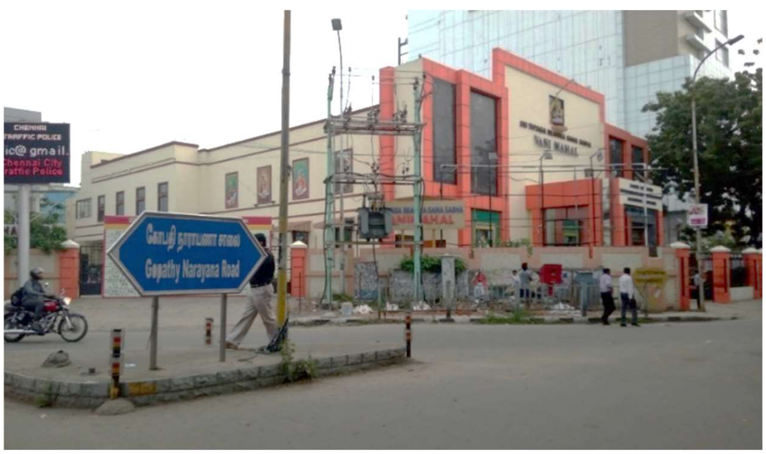


Figure 7.25: Urban elements on a street in T.Nagar
Source: Author (2017)

The next section explores the case of Coimbatore to make suitable comparisons between the two cities.

7.4 Case Study - Coimbatore

7.4.1 Geographical Setting and Urban character

Coimbatore, also known as *Kovai* in Tamil, is an ancient city that dates back to the 3rd century B.C. The district formed in the upland plateau region of the state, with the hill ranges of the Western Ghats flanking the west. The city that lies along the banks of the seasonal Noyyal river due to its geographical is not prone to water stagnation. The proximity of the Coimbatore region to the Western Ghats enabled the presence of rich fauna in the district. The undulating topography with its many depressions helped in the creation of several tanks for storage of rainwater for agriculture use. The fertile black cotton soil in the region and favourable climate and fertile black cotton soil led to successful cotton cultivation and the establishment of the textile industry, which became instrumental in the district gaining the name of 'Manchester of South India' (Government of TamilNadu, 2019). The city has nine lakes or wetland systems, enriching its urban ecosystem, namely, Ammankulam, Narasampathi, Krishnampathi. Selvampathy, Muthannakulam, Selvachinthamani, Periya kulam also known as Ukkandam Big tank, Valankulam and Singanallur. However, a part of the Ammankulam lake was reclaimed for constructing housing board tenements by the state government, along with some part of the lake bed lost due to encroachments such as informal settlements (Quadros et al., 2014; Priya et al., 2011)

Coimbatore is the 16th largest urban agglomeration[5] India and is part of the Coimbatore- Tirupur-Erode industrial corridor. The urban agglomeration area of the city along with its peripheral areas is approximately 1287 sq.km. city. The population of the city as per the census data 2011 is 1.05 million, and the population of the urban agglomeration is 2.13 million. The growth pattern was initially concentric and then developed along the major roads (Coimbatore Corporation City Development Plan,2006). In 2012, the city expanded to include the surrounding areas of Kavundampalayam, Kurichi, Kuniamuthur, Kalapatti, Saravanampatty, Thudiyalur, Vadavalli, Veerakeralam, Chinnavedampatti, Vellakinar, Chinniyampalayam and Vilankurichi. The area under the jurisdiction of the Corporation increased from 105

[5] As per Census of India, Urban agglomeration is a continuous spread constituting a town and its adjoining outgrowths, or two or more physically contiguous towns together with or without outgrowths of such towns Census of India, 2011, http://www.census2011.co.in/urbanagglomeration.php.

square kilometres to 257 square kilometres.14 After the expansion, the city is now administratively governed by being separated into five zones - North, South, East, West, and Central - and has 100 wards that are split between the zone sport expansion, the city is governed as five administrative zones – North, South, East, West and Central, with 100 wards shared between the zones (see Figure 7.26).

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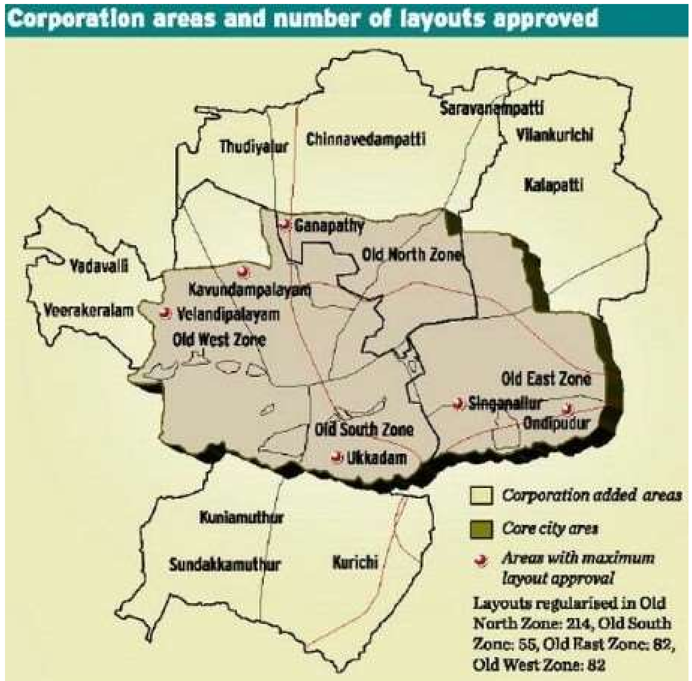

Figure 7.26: Map showing the city expansion in 2012
Source: Madhavan (2012)

The city became constituted as a municipal town with an area of 10.88 sq.km in 1866, and over the next decade, the town started developing into small scale industrial and administrative centre for the region. Rajashekariah (2011) documents the growth of the urban agglomeration of Coimbatore in a short period / The city occupied an area of 38 square kilometres in 1973 expanded to 79 square kilometres in 1989. The city limits were then further expanded in 2011 from 105.60 square kilometres. to 257.05 square kilometres include several municipalities and villages (TWADB, 2018). The city is a Municipal Corporation as well as the District Headquarters. The city has a Mayor, Deputy Mayor and several councillors elected by people representing administrative wards, as well as a corporation Despite being the most substantial revenue-earning districts, insufficient state government funds have resulted in the city's necessary infrastructure is underdeveloped.

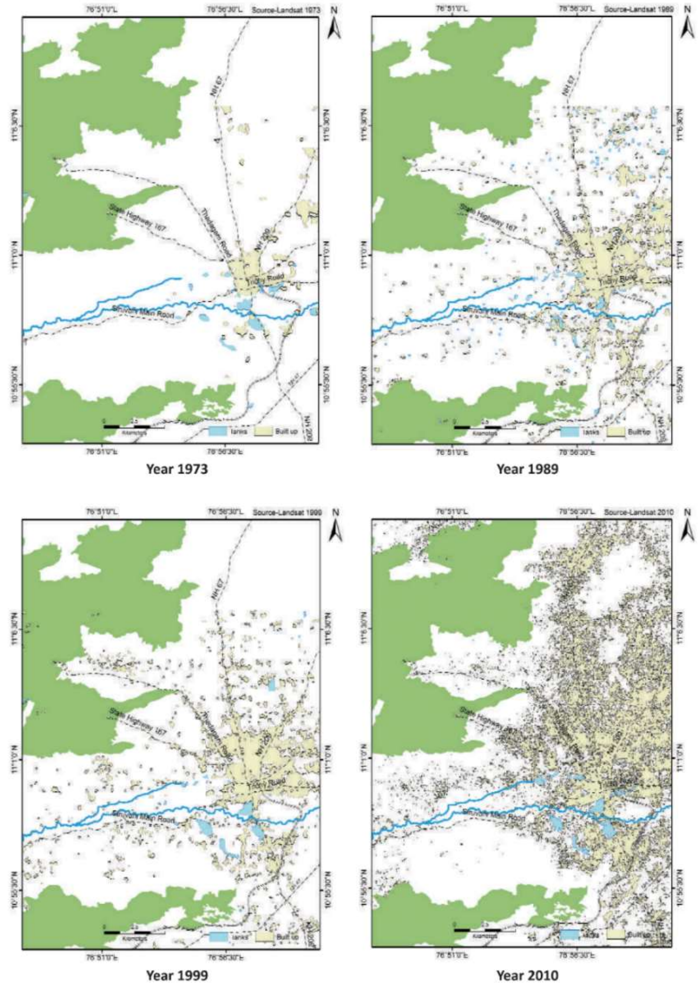

Figure 7.27: Historical urban growth of Coimbatore city from 1973 to 2010

Source: Rajashekariah (2011)

Either due to the influence of early British investments in the city or due to its resourcefulness, post-colonial Coimbatore emerged as one of the business hubs in Tamil Nadu. The current economic status of the city relies upon primary manufacturing, information technology and textile industries (Coimbatore District Administration, 2019). This is ably supported by two Special Economic Zones (SEZ) for attracting domestic and international investments into the city. Coimbatore is the second major commercial and business hub in Tamil Nadu after Chennai. The city's entrepreneurial roots have its basis in the last two hundred years. Under the British rule cotton cultivation was established as a critical commercial activity and this led to the setting up o first cotton yarn spinning mill, and later the first textile mill was instituted in 1888.

The development of the Pykara Hydroelectric power project in 1932 led to the flourish in the cotton industry, which resulted in the establishment of the governing body called Southern India Mills Association (SIMA) in 1933. Approximately 15 % of textile mills in India is located in the Coimbatore region, which is known as the textile capital of South India and hence called “The Manchester of South India”. The spirit of entrepreneurship spurred by the textile industry encouraged the foray into textile machinery manufacturing foundry base, for producing replacement spares. The foundry capability increased manufacturing activity of other machinery like Wet grinders, lathes, drilling and welding machines and diversified into automobile manufacturing, making Coimbatore a strong base for auto-components supply to the country. The strong cotton-yarn manufacturing base in Coimbatore along with adjoining Tiruppur town has resulted in a globally competitive hosiery manufacturing industry with a thriving export market (MSME-Development Institute, 2016).

In addition to the manufacturing and trading base, the last few decades have seen the rise in the Information technology sector and health services, hugely supported by the number of graduates that enter the job stream from the high-quality educational institutions in and around the city. The city is currently home to 50,000 micro, small and medium manufacturing enterprises in a wide range of fields. The experienced entrepreneurship skills, the ease in availability of skilled workforce, the abundance of resources and power have all led to Coimbatore region as the highest revenue yielding in the state of Tamil Nadu, even ahead of Chennai. The city has established itself as one of the fastest-growing second-tier metro cities in India and its highly ranked for its competitiveness (MSME-Development Institute, 2016). Following this, a brief overview of the urban character, the next section looks into major planning challenges facing the city.

7.4.2 Major planning challenges

The major planning challenges facing Coimbatore that impedes not just a sustainable growth for the city and its intent to become a smart city are highlighted in this section.

Urbanization and master plan mechanism

Coimbatore has a very fragmented city governance structure, due to shared jurisdictions of city and state agencies/ departments, often over the same services and operations. This situation is similar to most cities in India which leads to poorer delivery outcomes in many cases. The last approved master plan approved was drafted in 1991, for the period until 2001. Prepared by the state agency called the Local Planning Authority (LPA), it is an independent of the city corporation. The Coimbatore local planning authority functions under the control of Directorate of Town and Country Planning (DTCP) of Tamil Nadu. While the planning permission is issued by one of the agencies, DTCP, the building license is issued by the local city government. In addition to issuing approvals and preparation of plans, the DTCP website also enlists its role in special projects. Heritage town development of the identified 49 heritage towns/villages in Tamil Nadu comes under the purview of DTCP. The department, through its development plans, lays out the development regulations in these locations and prepares plans for beautification. The other special projects include preparing traffic and transport studies for management of traffic in 58 small, medium and large towns in Tamil Nadu, parks and playfield development and providing basic amenities in some cases (DTCP, n.d.-b).

The primary role of the DTCP in developing the regional cities like Coimbatore and towns includes preparation of the regional plan, master plan or new town development plan and detailed development plan (DD plan). The Tamil Nadu Town and Country Planning Act enacted in 1971, based on the Town planning Act in 1920 forms the basis for the planning regulations. The jurisdiction of (DTCP, n.d.-a) covers the entire state of Tamil Nadu, excluding the Chennai Metropolitan area. Based on the size of the building project, the planning permission is either issued by the municipal corporation, town panchayat or village panchayat and for larger projects, it is issued by the DTCP. Typically, the local body's power lies with issuing permissions for the following categories

The revised Master plan has been under preparation since 2005 and is not been finalised yet (The Hindu, 2019). As a result of series of delays, the current master plan is only a land-use management document and developments are approved purely based on the zoning model proposed in the document. The approvals are issued by the LPA, and the city government had to consult the LPA for any of its construction developments, which made it an impractical process. The outdated plan was not in line with the growing demands of the city as its provisions were inadequate to the changing needs, thereby resulting in a great extent of unauthorised developments. This included the illegal conversion of land use including agricultural land both within the city limits and along with the peri-urban areas, exploitation of land and resources by the private interests and establishment of non-regulated low-income settlements (The Hindu, 2018).

Further to the first master plan, a revised Master plan was prepared in 2007, based on feedback received, and submitted to the state government for conditional approval in 2011. However, the new plan never saw the light, following which there were reports on the preparation of a revised version of the Master Plan in 2014 (Kamath, 2015). This attempt for a new draft also did not materialise so far, though in early 2018 it was reported by the Local Planning Authority that the draft plan had been submitted to the state government for approval (The Hindu, 2018). However, as recently as late 2018, newspaper reports suggest that the plan is still under preparation by the appointed consultant (Preetha, 2018). The article highlights that due to the delay in implementing a revised master plan, the current land use classification is causing immense issues in controlling the developments.

Inspite of these endless master plan preparation delays, it is interesting to note that Kamath (2015) considers the city's governance structure has experience to execute urban development projects independently. Traditionally, infrastructure projects in the city were carried out under the aegis of the state government of Tamil Nadu, which directly commissioned, implemented and managed the city's infrastructure throughout its history, without devolving powers or funds to the urban local bodies. However, the World Bank's investment into the city's urban sector increased the city government's familiarity with working with external agencies. Therefore, when JNNURM, the programme that emphasised on greater autonomy to ULBs, it made fewer institutional changes to the city's structure and decision-making process, as compared to many other cities in India. Eventhough the master plan delays are causing significant issues to regulate growth in the city, it is interesting to note that JNNURM mission has had a positive impact on Coimbatore's city management.

Provision of Green Infrastructure

The wetlands in the Coimbatore city are known to have served the region for over 800 years. The river Noyyal and the 28 lakes that are fed by the river were designed to control floodwater from inundating the city, groundwater recharge and for irrigation purposes. The river Noyyal is a prominent feature that was also historically significant in shaping the settlements of Coimbatore districts and its surrounding regions. The river emerges from the Velliangiri mountains on the western ghats and flows from west to east, travelling 180 km, flowing through an area of 0.35 M ha and touching five districts of Coimbatore, Tirupur, Erode, Karur and Trichy (see Figure 7.28), before joining the river Cauvery (a large interstate river flowing between the states of Karnataka and Tamil Nadu). The excessive downstream flooding caused by the nature of its flow resulted in the creation of an ingenious system of lakes and dams spread over its course, by the Chola dynasty in the 8th and 9th centuries AD (Quadros et al., 2014).

Figure 7.28: Map of urban and rural settlements in the River Noyyal sub-basin

Source: Srinivasan et al. (2014)

With the positioning of the lake system, the city has a very structured, drainage system that acts at three levels with river Noyyal, being the primary drain. Among the various districts in Tamil Nadu, Coimbatore reported the highest level of water contamination in 2011, with almost 40 per cent of the sources tested were contaminated with either fluoride, nitrate, iron or faecal matter (Quadros et al., 2014).

Pollution

The population growth and increase in the establishment of around 40,000 industries of varying scales, primarily in the textile industry and foundries, led to the transformation of agricultural lands in the city. The release of untreated industrial waste from the western and northern portions of the city affected the biodiversity into the Noyyal river and the connected tanks. In the last few years, several NGOs have taken proactive steps to stop the pollution of the river system and to protect the boundaries by building bunds (Quadros et al., 2014).

Adding to this, as of 2011, only 37 per cent of the households within the CCMC area were connected to the piped sewer network, while 57 per cent connected to on-site collection system like septic tanks (Census, 2011). The study by Srinivasan et al. (2014) reveals that the surface water quality of the river Noyyal is found to be highly polluted with total dissolved solids, including faecal coliform and faecal streptococcus. In the zone classified within the Coimbatore part of the river, the pollution is mainly due to domestic discharge and to some extent due to industrial waste. Additionally, Coimbatore district is a semi-arid region and has one of the highest percentages of forest covers in the state, with almost 35 % of its geographical area distributed as forests. However, Coimbatore also has high levels of land degradation issues in Tamil Nadu.

A large extent of the expanded areas in the city do not have access to household toilets and if available are not connected to a sewer network. Public defecation and sometimes untreated sewage disposal into the water bodies remain mostly unchecked. Yagya (2017) advises eco-friendly technology of treating wastewater with the use of plants, natural coagulants, use of microbes and earthworms as treatment mechanisms that are effectively used in many countries. Door-to-door household waste collection at a zonal level is prevalent amongst the entire city area. Part of the waste is transferred to an 11MT bio methanation plant, and the energy generated is used for lighting (Yagya, 2017). Coimbatore has a multi-faceted pollution problem, including soil, water, and air pollution, in addition to solid waste management issues. The concept is ingenious and could reduce solid waste dumped into the Vellalore garbage yard. Similarly, the smart city project proposed desilting, cleaning and beautification works around the lake, may reduce the water pollution issues.

Provisions for Sustainable urban transport

Coimbatore, as one of the largest urban agglomeration in India, does not have a strong public transport infrastructure. A comprehensive mobility plan for the local planning area of Coimbatore was prepared in 2014 (TNUIFSL, 2014)..The current public transport system is mainly comprised of state-run bus services in conjunction with private bus operators. The surrounding villages and towns are serviced by these operators. The parking facilities and commuter facilities at the Ukkadam bus terminal is very basic, even though it is the main service point for access to neighboring towns and villages . The draft report identifies a very high reliance on private vehicles due to the non-homogenous availability of public transport. Only 40 % of the travel using motorised means is accomplished by public transport. The lack of facilities, reliance on bus infrastructure as the only mode, could be reasons for the reduced ridership.

Figure 7.29: Facilities at Ukkadam Bus terminal, Coimbatore

Source: Author (2017)

The mobility report (TNUIFSL, 2014). also indicated that the growth in the number of private vehicles is higher than the population growth of the city and therefore a reduced usage of the non-motorised form of transport and walking as modes of commuting. This situation, in addition to the location of bus terminus within the main city areas of Gandhipuram and Ukkadam, also contribute to the traffic congestion. Some of the key challenges that hamper the adaptation of these modes are either the complete lack of footpaths, with almost 80 % of arterial roads lacking footpaths, and 75 % of existing footpaths in the CBD area of the city are poorly maintained. One of the key recommendations of the report is the improved provision for pedestrian subways, footpaths and road furniture in the core areas of the city The footpaths, if available lacks continuity and does not have any provisions for the disabled (see Figure 7.30)

Figure 7.30 : An unfinished foot path along an arterial road in Coimbatore

Source: Author (2017)

7.4.3 Proposed Smart City changes

Smart city proposal of Coimbatore gained thirteenth position in the city challenge, which higher than Chennai's eighteenth position. This is possibly due to the unique area- based development proposal put forth by Coimbatore. The concept plan to connect eight city lakes using cycling and walking tracks, is unique among the first twenty cities who won the city challenge. The key components of Coimbatore's area-based development proposals include the following

- Compact - the redevelopment of existing areas and densification of peripheral areas
- Public open spaces-walkable lakefronts and green pathways
- Transport-integrated redesign of public transport and NMT roads
- Walkability- 30km green pathway with cycling walking tracks and NMT streets
- Inclusive Housing-and social infrastructure and livelihood protection for urban poor
- Water supply management- 24*7 PPP ongoing project
- Wastewater management- 100% access through sewerage provision
- Safety and security

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The pan-city proposals include,

- Intelligent traffic management system using surveillance cameras, signal synchronization, number and license plate recognition, speeding and red-light detection
- Command centre for crime prevention, traffic regulation and disaster response
- Air Quality Monitoring using sensors
- Energy-efficient and LED street lighting on all roads

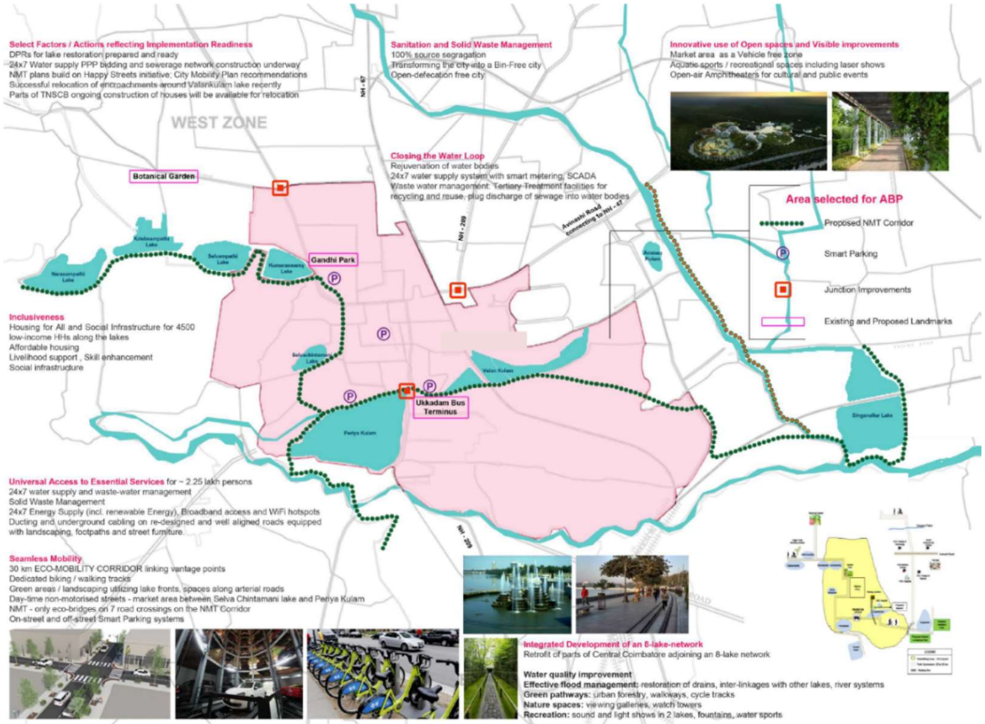

Figure 7.30: Arrangement of Walking and cycling tracks proposed along the lakes

Source: Coimbatore Smart city proposal-downloaded from www.smartcities.gov.in

As indicated in figure 7.30, Coimbatore has inadequate pedestrian facilities with pedestrian walkways available only alongside new developments along specific stretches. Most neighbourhoods in the city including major arterial roads terminate with stormwater drains that are often clumped with undergrowth. Contexts are very crucial in understanding the relevance of smart city proposals. At the second anniversary of the smart cities launch, Coimbatore's smart road project was lauded as one of the success stories in the mission cities. The 'smart road' project, proposed for a total length of 49km is essentially an up-gradation of the existing roads with improved pedestrian facilities and amenities to achieve 'complete streets' (MoUD, 2017). However, Coimbatore smart city faces several challenges.

Figure 7.31: Smart tree-Wi-Fi hotspot

Source: Coimbatore smart city Facebook page

After the initial hiccup due to political instability in the state, Chennai started making good progress on smart city projects. However, based on news articles from various sources, its is evident Coimbatore smart city projects has been plagued with a number of issues (see Figure 7.32). The delays are due to a variety of reasons including technical inadequacy, inability to appoint qualified contractors to carry out the works and obtaining clearances from the smart city high-power committee. One of the projects that is highlighted in the Facebook page is the smart tree Wi-Fi hotspot tree installed in one park. The Facebook page, otherwise, posts more information on the Clean India mission, compared to the SCM. While Chennai's smart city's social media and online presence is strong, the smart city website of Coimbatore, is under construction since 2017.

NEWS / CITY NEWS / COIMBATORE NEWS / HEAVY RAIN EXPOSES CIVIC BODY'S LACK OF MONSOON PREPAREDNESS

THIS STORY IS FROM OCTOBER 23, 2019

Heavy rain exposes civic body's lack of monsoon preparedness

TNN | Updated: Oct 23, 2019, 13:30 IST

A- A+

COIMBATORE: Inaccessible roads, drains filled with silt and non-functioning street lamps - the recent showers have exposed the city's poor performance in putting basic infrastructure in place. And now, residents want the city corporation to focus on improving basic amenities, instead of beautifying the lakes as part of the smart city project.

THIS STORY IS FROM JULY 29, 2019

Three smart city projects hit roadblock

Nivedha Selvam | TNN | Jul 29, 2019, 12:04 IST

A- A+

After successfully completing the pilot study at RS Puram for the bicycle sharing system, the civic body had p... Read More

COIMBATORE: The initial enthusiasm that the city corporation had shown in 2017 to implement the smart tree project, bicycle sharing system and digital display board project has faded out and today even the public seem to have almost forgotten these projects.

The three projects were launched as part of the smart city mission. The civic body had finalized contractors for the projects to be implemented under the public-private partnership model and commenced the works briskly.

While smart trees were to be set up at 25 locations, digital display boards were to come up at 30 locations in the city. Inaugurated by municipal administration minister S P Velumani in last August, the smart tree project had received much appreciation from the public, as it came with wi-fi facility, multiple charging points, rainwater harvesting structure and solar panels.

Narasampathy lake project: Corporation to float second retender

TNN | Updated: Dec 14, 2015, 11:26 IST

A- A+

The civic body has been searching for a suitable bidder for the last four months

COIMBATORE: The city corporation is getting ready to float retender for the second time to execute rejuvenation and restoration work at Narasampathy lake under the smart city project.

The civic body has been searching for a suitable bidder for the last four months, a corporation official said. "We had to reject the bidder as they did not fulfil the eligibility criteria. Now, we have no option but to float another tender," he said.

The corporation had obtained approval from the high-powered steering committee of the smart city project to restore and beautify eight lakes Valankulam, Selvachintamani lake, Periyakulam, Krishnampathy lake, Selvampathy lake, Kumarasamy lake, Narasampathy lake and Singanallur lake in two phases at the cost of Rs 212 crore. Each project has hundreds of components like non-motorized tracks, pedestrian paths and sewage treatment plants.

One and half years on, model road project yet to get clearance

TNN | Sep 11, 2019, 12:59 IST

A- A+

According to a source, every time the project inches closer to the clearance, the competent authority suggests... Read More

COIMBATORE: Almost one and a half years have lapsed since the city corporation submitted proposals to turn two of its important auxiliary roads into pedestrian-friendly ones by incorporating innovative features, but the project is still stuck at the designing phase.

The proposal to convert Race Course and TV Samy Road into model roads was submitted along with the proposals to implement the first phase of lake restoration and rejuvenation project at Periyakulam tank, Selvachintamani tank and Valankulam tank. While the latter has received the go-ahead and works are on full swing, the city corporation is struggling to get clearance for the model road project.

THIS STORY IS FROM APRIL 9, 2019

Pilot phase of lake project to be completed by May

TNN | Apr 9, 2019, 11:27 IST

A- A+

The beautification of Periyakulam lake

COIMBATORE: The city corporation, which was planning to complete the rejuvenation and beautification work on the 1.8km stretch of the northern bund of Periyakulam lake along the Perur Bypass by April, is yet to complete work even on the 100m stretch, which was planned as a pilot project.

The civic body had launched the Rs 39.74crore quick-win project of the smart city mission on July 5. It was expected to be completed by April, during the summer vacation for school students as the place is one of the recreational spots open for public.

THIS STORY IS FROM OCTOBER 20, 2019

40-minute shower sinks 'smart city'

Pratiksha Ramkumar | TNN | Oct 20, 2019, 12:47 IST

A- A+

Several two-wheeler users were seen parking their vehicles on the middle of the roads, waiting for water to re... Read More

COIMBATORE: Exposing the sorry state of the urban infrastructure, traffic came to a standstill on the otherwise busy Mettupalayam Road and Thadagam Road after the 40-minute rain on Thursday evening.

Vehicles, mostly two wheelers, were stranded on the stretch between the Old Avinashi Road Flyover till Saibaba Colony due to water-logging. The Mettupalayam Road and Thadagam Road were under two-foot water. Water also entered houses along the roads.

The 60ft wide Poo Market Road and the 80ft wide R S Puram Road had shrunk to less than 20ft as water stagnated along the stretches.

Stagnant water along the roads forced two-wheeler users stop their vehicles. "There are massive potholes and trenches on corners. I don't want to die," said Sundaresan, an office-goer, who took shelter at a juice shop on the Mettupalayam Road.

Figure 7.32: Reports on project delays on Coimbatore smart city

Source: Various newspaper sources

7.4.4 Analysis of urban design quality

It is challenging to ascertain Coimbatore’s attitude towards urban design. There is hardly any literature that discusses the need for urban design focus in the city or any project initiatives in this connection. This issue is not restricted to Coimbatore but most tier-2 Indian cities. The city along with the neighbouring villages lend a town like character to the city, a sharp contrast to the buzzling metropolis like Chennai. In this context, this section analysis the urban design qualities of Coimbatore to understand the ‘place’ component of this aspiring smart city.

Mixed-use

Despite being a city of considerable geographical size, population and history, Coimbatore does not have any specific urban design policy. The primary tools for management of the built environment are predominantly controlled by the town planning regulations set out by the Directorate of Town and Country Planning (DTCP). As mentioned in section 7.4.2, the continued delay in finalising the master plan is detrimental to the overall development of the urban area. Even though the city is the second-largest urban agglomeration in Tamil Nadu, most part of the city has the urban character of a town, with its broadly low to medium-rise urban form. However, this also gives an enabling environment for activity at the street level.

As in the case with Chennai, mixed-use by way of small business establishments, neighbourhood level convenience stores and tea shops are integral to residential neighbourhoods in Coimbatore. Figure 7.33 shows a typical residential neighbourhood in the central area of the city. This particular location had a series of small business establishments at the lower level and residential accommodation at the upper levels. Most of the business owners like the pawnbroker (first shop) lived in the upstairs residences, making it a convenient arrangement. Additionally, pushcart street vendors selling vegetables (far end of the picture) increases the vitality and safety of the neighbourhood. At the neighbourhood level, the Coimbatore has a good mix of existing neighbourhoods promoting activity and vitality at the streets level.

Figure 7.33: Typical residential streets in central Coimbatore
Source: Author (2017)

Sense of place

Unlike Chennai, Coimbatore does not have many buildings of historical character. The Town Hall, the centre of the city, is a prominent building, where the offices of the municipal corporation operate. The pre-colonial building along with to the other government buildings signifies the seat of power in the Town Hall Junction area of the city. In addition, few prominent temples, the Coimbatore railway station, Ukkadam bus stop (see Figure 7.34a) are the prominent place markers in the cityscape, like the Similarly the Race Course road in the city is another prominent land mark with tree lined avenues and walking tracks, with a good sense of place dimension. However, barring these few landmarks, the rest of the city is redundant of any specific characteristics. Occasional urban elements like the stupa in the round about (see Figure 7.34b), help in the wayfinding experience of the city. Most areas of the city can be closely linked to any other cities in Tamil Nadu like Trichy or Tirunelveli.

Figure 7.34a: Market near Ukkadam bus terminal, Coimbatore
Source: Author (2017)

Figure 7.34b: A roundabout with a stupa, Coimbatore
Source: Author (2017)

Legibility

The streets in Coimbatore are characterised by poor design and management, that has resulted in congestion, air pollution and road safety issues (Shanmuga Priyan et al., (2017). Some of the major intersections in the city that has these issues include Ukkadam Junction, Town Hall junction, Gandhipuram Junction and Peelamedu Junction. These locations have numerous planning and design issues that affect the efficient use of these spaces. For instance, Ukkadam junction (see Figure 7.35) is one of the key locations in the city with the presence of an integrated bus terminal, that caters to intra-town commuters as well as local inter-city commuters. However, parking is highly unregulated with private autorickshaws encroaching one side of the road. Informal paid parking arrangements by local landowners are the primary form of parking in this junction. Sometimes bus drivers using the road or entrance to the terminal to board and alight passengers, instead of doing the same within the designated bays of the terminal, adds to the congestion issues. The Ukkadam junction is adjacent to one of the large lakes in the city namely Periyakulam. The lack of distinctness in road space usage, appears to be an issue in both Chennai and Coimbatore.

Figure 7.35: Lack of defined street space

Source: Author (2017)

Adaptability

Similar to Chennai, Coimbatore is low on adaptability factor. The city does not have any public spaces for adaptive use of the public space. Similar to Chennai, informal make do shops are present in most areas of the city. Due to its proximity to surrounding villages, people from these villages come to sell their produce or wares (see Figure 7.36). . From the ethnographic analysis, there was no evidence of adaptability in the built environment of the city. However, with the smart city proposal, focused on expanding recreational activities in the city, adaptable use of the lake fronts and other informal areas might improve the quality of city life.

Figure 7.36: Lack of adaptable spaces

Source: Author (2017)

Compactness

Yagya (2017) notes that tremendous economic activity and its diversification played a vital role in the spatial expansion of the city in the past few decades. The economic drivers of the city were always keeping abreast with the globalisation and liberalisation trends of the country. The expansion of the city boundaries in 2012 is seen as a reflection of these expanded activities. The growth primarily happened along the main arterial roads leading to the surrounding major cities of Trichy, Cochin, Palakkad and the towns of Sathyamangalam, Palakkad and Mettupalayam. Growth also happened along with the peripheral towns of Singanallur, Ondipur, Maruthamalai, Seeranayakanpalayam, Kumarapalayam and Vilan-kuruchi. An aerial study (see Figure 7.36) of the Peelamedu area on the north western part of the city, indicates increased urban footprint and density, in a 14-year period. Fortunately, for Coimbatore, unlike Chennai, the western ghats mountain ranges provides a natural urban growth boundary for the city.

Figure 7.37: Urban growth pattern of Peelamedu (2006 to 2019)

Source: Google Earth

Public realm

Bhatia (2019) states that most Indian cities were losing close to 20 % of the public space towards development as a serious issue. The open spaces are lost either for regularisation of slums by constructing new housing or for other commercial uses. Urban infrastructure facilities like roads, utilities, bridges, housing, and establishing transportation facilities also take priority in city planning and override other vital spaces such as art galleries, libraries, sporting facilities and museums. Bhatia (2019) explains that the 'hard' infrastructure forms the skeletal system of the city and vital for the economic progress of the city, and the 'soft' infrastructure is essential for overseeing the social and cultural development of the citizens. However, 'soft infrastructure is often overlooked for economic development and has led to several cities having commercial and shopping activities being overdeveloped in public spaces and diminished priority for open spaces and cultural or social amenities. The poorly maintained children's park (see Figure 7.38 L) and a visually poor quality public realm (R) along a street corner.

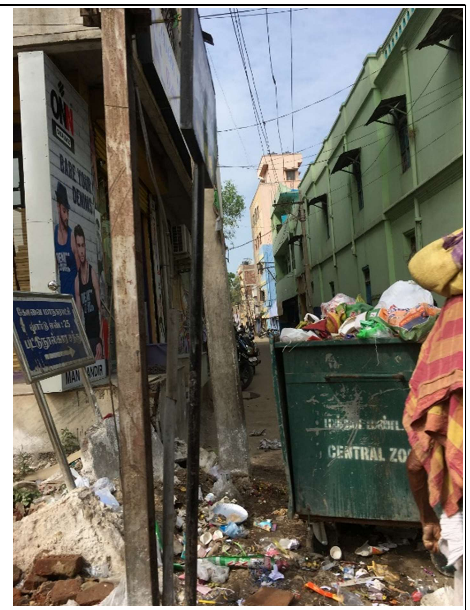

Figure 7.38: (L) Gandhi children's park in Koyambedu
(R) A street corner in central Coimbatore
Source: Google Earth

Coimbatore is naturally blessed with a natural water ecosystem and is a strong part of the city's public realm. However, the water edges and banks of all the eight lakes is not well-defined or suitable for amenity and pleasure of the community. The lakes themselves have algal blooms rendering them useless for recreational purposes. Unlike Chennai, Coimbatore has less social infrastructure facilities. The only entertainment avenues are cinema halls are three shopping malls in the city. The smart city area-based development proposals aim to address these lacunae.

7.4.5 Summary

The analysis has helped to identify the distinct characteristics of the urban areas of Chennai and Coimbatore. The purpose of this analysis was to determine the overall urban quality of the two cities using the six urban design action indicators established in chapter five. Based on the investigation, the performance of the two cities for the respective urban design area is tabulated and presented as table 7.1 and table 7.2.

Table 7.1: Analysis of urban design quality - Chennai

Urban design action areas	**Chennai**		
	Low	**Medium**	**High**
Mixed-use			
Sense of place			
Legibility			
Adaptability			
Compactness			
Public realm			

Table.7.2: Analysis of urban design quality - Coimbatore

Urban design action areas	**Coimbatore**		
	Low	**Medium**	**High**
Mixed-use			
Sense of place			
Legibility			
Adaptability			
Compactness			
Public realm			

The most interesting aspect of the tables is that Chennai scored only slightly better than Coimbatore in terms of an overall sense of place. Both cities scored poorly on a number of areas like legibility, adaptability, compactness and public realm. Furthermore, in spite of the smaller footprint compared to Chennai, Coimbatore's low score on compactness is mainly due to poor public transport options and high reliance on private vehicles.

7.5 Conclusion

The chapter helped in understanding the quality of urban spaces in Chennai and Coimbatore, analysed based on the six urban design action areas for smart cities. In summary, the results showed the need for an urban design focus in the two cities. It was evident from the study that Chennai had better investment into urban infrastructure than Coimbatore. Based on the ethnographic studies, comparatively, Chennai had more better-quality public spaces for community use compared to Coimbatore. Mixed-use character is a strong point of both the cities, although both cities scored poorly on most other urban design quality assessments. Overall, these results contributed to understanding the barriers of place-based design. Chennai, through its smart city mission, has made progress in overcoming some of the challenges. However, lack of social infrastructure in Coimbatore was evident from the studies. Similarly, pollution was a huge cause for concern in both cities. Chapter eight is the second part of the case study, with analysis of the key-informant interviews.

CHAPTER 8

CASE STUDY: BARRIERS AND OPPORTUNITIES

8.1 Introduction

The chapter illustrates the interview findings from the two case studies to understand the barriers and opportunities for the smart Indian cities. The analysis is based within the premises of the seven smart city dimensions. By using the proposed smart city theoretical framework to analyse the empirical findings of the case study presented in chapter seven, gives a wholesome understanding of how the smart city development process in India can be achieved. The previous section discussed the current urban character and the possible effects of the SCM on the urban qualities of Chennai and Coimbatore. The analysis made from field trips and visual observation, along with secondary literature sources, revealed numerous insights into the urban qualities of both cities. However, it is also important to understand the perspective of the stakeholders involved in the city building process. This chapter is the second part of the case study , and together with chapter seven addresses research question number three, The interview data from the interviews conducted with the key informants in both the cities is analysed in this chapter, to understand the barriers and opportunities for implementing smart cities in India. The information in this chapter is organised in three sections. The first section discusses some of the challenges in conducting qualitative interviews that are specific to the Indian context, along with a brief overview of the interview analysis methodology. Section two investigates the opportunities for the mission, and sections three review the barriers derived from the interviews based on the seven dimensions of smart cities, including urban design. The direct quotes from the respondents, wherever used, has been reproduced without proof reading.

8.2 Qualitative studies in India

In order to understand the way in which the different agencies/actors were involved in shaping the city building process and their power/influence to control the elements of the public space. This would provide a greater comprehension of how the key stakeholders influence the city's urban design. Therefore, for each of the case study cities, key stakeholders such as academics, planning officials, urban designers, non-governmental organisations and real estate developers were identified through documentary review and interviewed. The majority of the respondents had a direct role in the smart city process (see Figure 8.1). In general, in Indian cities, control over the design elements is primarily over the external appearance of the buildings, with disregard for the quality of the public realm design. Development control guidelines, along with government planners, have more control over the quality of urban design in India than any other factors.

Qualitative interviews were conducted from December 2017 to May 2018 with the above group of respondents who were predominantly engaged in the field of urban planning and design and smart cities. Given the nature of the research involved and the lack of urban design focus in Indian cities established in chapters three and seven, a survey of the community was excluded in the research design. Therefore, only respondents who are familiar with the city planning process, and who are either directly or indirectly involved, were interviewed in both cities. In order to protect the identity of the individual respondents and to ascertain the researchers' ethical standpoint, the individuals interviewed were kept anonymous. Participants were targeted based on an explorative approach that started with the themes of urban design, urban planning and smart cities. Following an initial review of the literature and preliminary data analysis of the smart proposal, the interviews led to the comprehensive exploration of the urban design approach in Indian cities. The respondents were individuals who were involved in shaping the smart city journey either by their direct involvement or people who had a shared interest by the nature of their job (see Figure 8.1).

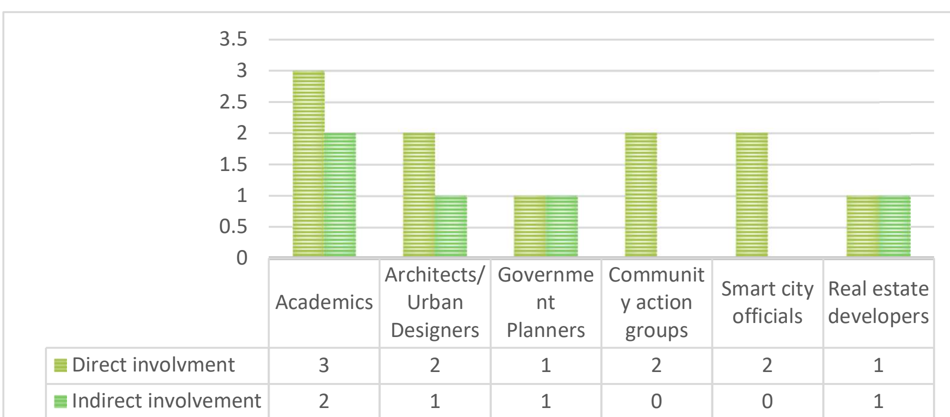

Figure 8. 1: No. of respondents with links to SCM

Source: Author's elaboration

An analysis of articles from established newspapers like The Hindu, The Times of India and the New Indian Express, which were pan-India English newspapers were also used as part of the literature study. As the data collected from the interviews were mostly qualitative, it was analysed firstly by manual transcription by the researcher, followed by a review to understand the broad themes. The transcripts were then coded using NVIVO to obtain a more detailed understanding. The frequency of similar responses in addition to innovative approaches and suggestions that validated the literature was the critical features examined in the analysis. Each respondent's' answers to the questions were condensed to the main points that were then compared to responses from other interviewees to identify common themes. The primary outcomes of the interview themes are discussed below. As described in the methods section, sixteen participants were interviewed for this research. Several critical observations by the respondents helped create a picture of challenges and opportunities in the smart cities' implementation in the case study cities. The research revealed that most of the participants highlighted a lack of an urban design approach in Indian cities

One of the critical aspects of interviewing in India is to be aware of certain cultural understandings within society and the power dynamics involved. Educational qualification is generally highly regarded in Tamil Nadu's society. Though professionals have a high social standing, government officials will expect respect and gratitude for any information provided, even though it may be deemed public. Most officials, especially in local government, do not have official email addresses as the email is general for specific sections within a department. Some officials might even use their personal email for conducting official work. However, it is common for high ranking government officials to have personal email addresses included on their official business cards. Making appointments by phone or email is tricky as firstly, it is difficult to obtain the direct number of these officials from websites, and even harder to obtain email addresses. For instance, in 2017 when these interviews were planned at CMDA, which is a large organisation with shared offices in a multi-storied complex in the core area of the city (see Figure 8.2), with hundreds of employees did not provide any specific contact details of different departments. However, this changed in 2019, and in their currently upgraded website, the names and direct line phone extension numbers of chief planners, senior planners and deputy planners are included for central departments such as Area Plans Unit, Master Plan, Road Transport Division, Regularisation Wing (for unapproved buildings/plots/layouts), Enforcement Cell and a number of other special projects categories.

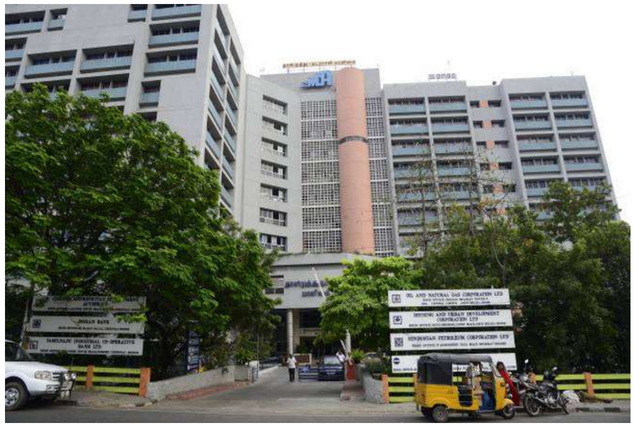

Figure 8. 2: Exterior of CMDA offices in Chennai

Source: Author (2017)

The working culture in most government departments is very informal, and sometimes meetings are planned at short notice, forcing the officials to adjust their workday. In Chennai, the CMDA comes under the purview of the Housing and Urban Planning Department and is generally regarded as a highly sought-after portfolio among government ministers. The CMDA is headed by the Chairman who by default, is the Minister-in-charge of the department. The other members of the administrative committee include the Vice-Chairman, Principal Secretary/Member Secretary and the Chief executive officer, with the last three roles permanently filled by the IAS officials (Indian Administrative Services as part of All India Civil Services). Like most democracies, planning in India is highly interlinked with political systems, and therefore planning officials are highly directed by the incumbent government and its policies in India. Given the nature of their job, the officials also must go away sometimes on unplanned site visits to development project sites, making it challenging to fix appointments. Sometimes these visits or impromptu meetings are set up by high ranking officials or Ministers at short notice, which the officials must oblige. Sometimes the researcher had to go to the offices up to three times, to meet up with an official and fix a suitably convenient time at a future date. However, in some cases, the officials were very hard pressed for time between these formal/informal/scheduled/unscheduled meetings, which are inter-departmental or intra-departmental. Despite the interview scheduling logistics, most officials were accommodating and interested to talk about the subject. They were genuinely interested in expressing their views and in helping to provide information for the research.

The most widely accepted yet unwritten social norms that need to be followed when interacting with people of power relates to the cultural aspect While Tamil society (people belonging to Tamil Nadu), and the larger Indian society generally highly regards educated and qualified individuals, the power distance is a crucial aspect of being aware of Geert Hofstede, the Dutch social psychologist who researched various cross-cultural groups and organisations, arrived at a series of parameters to understand the dynamics of working culture in various countries in the world. The Culture Compass™ developed by Hofstede using the 6D model (Hofstede Insights, 2019), rates one of the dimensions, power distance, in India as 77 out of 100. According to Hofstede, power distance relates to “the extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally”. India’s high score reflects that there is a general expectation for an appreciation of hierarchy due to its top-down structure. The management is more paternalistic, and at most times, accessibility of superiors is at one level above only. Communication is top-down, and employees too would expect clear directions to carrying out their functions. In contrast or to understand this power distance ratio in perspective, Australia’s score for the same aspect is 36 out of 100. This score of Australian organisations indicates that generally, the hierarchy is more for convenience and higher-ranking managers are highly accessible, engage their employees and consult with their teams on their expertise.

A further aspect to consider when conducting interviews is the way of communication while addressing the individual. Though most business both in private and in government offices is carried out in English, the need to have at least a working knowledge of the local language of that particular state is very important in India. Professionals and highly ranked officials would expect to carry out conversations in English. Proficient conversations by means of the English language is highly regarded within Tamil society. It is quite common in cities like Chennai where a conversation in the local language would often be adorned with English passages. Due to the power distance aspect, one must often address the person as 'Sir', which is the highest level of respect that could be expressed in the English language. However, most Indian languages have several suitable suffixes and prefixes to address people who are older than oneself or as a mark of respect to those who hold power. Failure to show respect will often lead to partial or non-cooperation or sometimes even complete disregard of one's requests.

Staff working for the government, even as a peon, who is the lowest ranking staff in a government department", would expect to be treated and addressed with respect. In some offices, the 'peon' who has multiple roles as a doorkeeper cum assistant, has the power to arrange a meeting with the person-in-charge either immediately or after making one wait for half a day in the corridors. Withholding due respect will sometimes lead to adverse effects such as the official not being informed of one's presence, thereby prolonging the waiting period, which might end sooner if there is a lucky chance of the official stepping out of his/her room for some other engagement. This author had the advantage of understanding these power dynamics while working as an architect in Chennai, and the necessity to obtain approvals from various government departments depending on the type and size of the project in question. Working as an architect in Chennai means not only to be familiar with the National Building Code of India and the second master plan of Chennai, which constitutes the local planning regulations, it was also essential to be able to interact with the planning authorities sometimes to negotiate the best planning outcome for the Client. This previous knowledge came to be highly useful in obtaining access to offices and conducting interviews. Barring one interview, which was conducted over the phone, all other interviews were conducted face-to-face in India. The phone interview was with an Indian academic cum architect, who is partly based in the United States of America and Mumbai. Despite the minor challenges, conducting interviews in India was an interesting experience, and the semi-structured nature of the interviews helped in gaining new knowledge (previously unknown to the researcher) in the study area.

As the interviews were analysed step by step to sift through the data generated, the information contained in the interviews was codified to fit within the seven smart city dimensions, which helped in understanding the content more systematically. This presented several challenges as some of the opinions were overlapping into two different dimensions, causing a dilemma in allocating it to the right discipline. For instance, the lack a holistic vision by the government was a key point which could fit both within the governance and environment parameters. As urban planning is contained within the environmental dimension in a smart city, this key point was, therefore categorised into the environment dimension. Likewise, the interview content had to be re-read several times to capture the true nature of the feedback received and then tabulated.

Further to this exercise, the key points were refined and further segregated as either barriers or opportunities for the respective cities. This helped in gaining a clear understanding of the various issues that face the SCM, especially in Chennai and Coimbatore. Even though most of the feedback received was specific to these two cities, it was also generic and found to be common to several Indian cities. The following discussion highlights the key points that emerged from the interviews, arranged under seven dimensions. Quotes from the respondents and specific inputs are cross-referenced using coded abbreviations; for example, KI-1 indicates key informant-1. The list of the interviewed respondents, their designation and identification are included in Annexure – D and the questions in Annexure - E. The data from the interviews are presented thematically in the following sections.

8.3 Opportunities for the mission

From the qualitative interview studies, a number of opportunities were identified from the SCM. As highlighted in chapter six, the SCM provided an opportunity for cities to become the main topic of discussion. Prominent cities like Mumbai, Delhi, Kolkata, Chennai, Bengaluru and Hyderabad are always in the public mindset due to their high contribution to India’s GDP. This, coupled with the population in these cities, enables relatively substantial investment in development projects, either from the central or state governments. Contrastingly, the second-tier cities and smaller cities are not given due priority for development. Therefore, the first positive outcome of the mission is the program structure which enabled cities to be judged based on the merit of the proposals rather than the economic stature of the cities. In addition to this perspective, two other main opportunities from the mission to cities in India are discussed below.

Investment in cities

As the SCM was launched by the Central government, an overwhelming majority of the respondents considered the mission as a welcome initiative. more importantly, in the words of two academics, one from each city, that any investment in cities is much needed as it has been delayed for too long. Another expert iterated that given India is the second most populated country in the world with a high %age of people living in urban areas, this mission is necessary *(Academic, KI-9).* Indian cities, in general, have a not so enviable track record of delays when it comes to public projects. An academic *(KI-1)* from Chennai believed that since the SCM itself is time-bound, including resources and projects, it might help in overcoming the delays

Chennai based academic envisaged economic and social benefits of the mission in terms of increase in real estate developments leading to improved job opportunities, better infrastructure and transport solutions, a holistically integrated urban planning, retrofitting and redevelopment, which would all contribute to improving quality of life of the residents *(KI-2).* Likewise, academic *KI-7* stated that the mission has drawn attention to the urban questions in Indian cities and therefore might have an impact on the way policymakers, city administrators and the public look at the city. It could also improve the quality of the governance model currently prevalent in cities. However, the real measure of the impact on how the mission is going to change the landscape of the city can be adjudged only after another five years *(Academic, KI-7).* Even though the mission focus is to develop one suburb as a pilot area in the city in as many as one hundred cities, he commented that "*one city, that too a small part of a city will be a smarter one. Even the rudimentary facilities are not available in a majority of the cities and for the major segment of the population. This is one critical appraisal of this project; otherwise, any investment for any city is welcome.* "

The response from urban planning and design professionals on the relevance of the SCM in India was also positive. Coimbatore based architect/urban designer felt that the mission had opened opportunities for design professionals involved in architecture, planning, urban design and landscape architecture. He also highlighted that the majority of the twenty cities selected in the first round of the city challenge had made it to the list due to innovative ideas or a specific theme, acting as precedents for future Indian cities *(Urban Designer, KI-11).* New initiatives, as part of the mission like dedicated cycle lanes, were acknowledged as exciting by another design professional *(KI-5).* Another respondent felt that this mission has undoubtedly ignited the talk about cities bringing city planning into the forefront *(Urban Designer, KI-4)* and believed that improvements in the cityscape are crucial at this time as most Indian cities are bursting, it seems, due to unplanned growth models *(Urban Designer, KI-5).*

However, there was also caution and scepticism; an urban designer from Chennai *(Urban Designer, KI-4)* was particularly critical that though the mission's intent was positive, the proposals of most cities were merely repackaged projects that were incomplete or lapsed from the previous JNNURM mission. Similarly, although, the smaller cities for the first time have begun to view their planning process and have garnered much serious attention. They seem to be trying to project or are getting carried away by the fancy, upscale and flashy visual imagery proposed by external consultants, who are often backed by multi-national agencies. This urban designer also warned that there is lack of creation of a holistic vision for the city, and due to the financial and time constraints posed by the mission guidelines, projects are not so coherently chosen but chosen based on the money available. Since this is more visible to the community, which is viewed mostly as a vote bank, it, therefore, limits the effectiveness of the SCM *(Urban Designer KI-4).* The government urban planner from Chennai *(KI-3)* although commending the intent of the project, was critical of the way the implementation of the project was carried out.

The majority of the respondents from both cities felt that the smart city proposals would have a positive impact on the urbanscape of the various cities. However, the common concern among many was reflected in the words of an environmental activist from Coimbatore *(Community action group, KI-12)* who said that "*it is a very good initiative provided it is implemented in the right spirit*" and "*Smart city is not possible only by the government, it has to be involving the citizens in a large way…"*

As mentioned earlier, this chapter will look into the key outcomes of the interview analysis within the boundaries of the smart city dimensions. Though some cautionary words were expressed, the response to the mission was overwhelmingly positive and was widely welcomed by the majority of respondents.

City image and Competitiveness

Sense of pride associated with city image is often conveyed through informal conversations in India. Even though state-level performance indicators are released regularly, city-level performance data is not often released. The SCM, along with other initiatives like Clean India campaign and the recently launched 'Ease of Living index,' are all aimed at boosting city-level competition in order to improve the cities liveability performance. The SCM city challenge was the first of its kind in India which was acknowledged by real estate developer from Chennai (*KI-08)* for being instrumental in improving the sense of competition among cities. He stated "*that this exercise is also unique… It was more of a competition. Early it was not that"* and also mentioned *"that is the win-win situation about that... So, the competition really made it different".* Even among some respondents from Coimbatore, the selection of the city in the first-round national competition was mentioned with a sense of pride, though some of them were concerned about the delays in the execution of the project. Similarly, an urban designer from Chennai (KI-04) also appreciated that the mission contributed to the positive city image. While there was much positive feedback, an urban designer (KI-04) from Chennai was also critical about the city image perceived by the SCM for tier-II and tier-III cities for the SCM. The designer found the aspirations to upscale on par with the nearest metro city as glaring. Her concern was that these aspirations might affect the balance for a transect of villages to cities of varying sizes. However, the aspiration to a positive city image is an encouraging aspect.

8.4 Barriers to India's Smart Cities

More than the opportunities, several barriers were identified from the interview data. The following sections explore the interview data to discuss these barriers within the six dimensions of smart cities, in addition to the contributing urban design dimension.

8.4.1 Barriers to Smart Governance

A significant number of governance-related issues were identified by the various respondents both in Chennai and Coimbatore. Some of the key themes that emerged from the discussions included delays in decision making, red-tape, devolution of power to local governments, top-down approach, the need for improvement in the level of transparency, implementation and enforcement hurdles, and co-ordination between government agencies. These issues are discussed in detail below.

Delayed decision making

Delays in decision making are seen as a significant impediment under the governance-related issues discussed. As seen in section 3.3.2, several shortcomings were found in implementing the JNNURM mission, one being delay in decision making and implementation. The intent of the SCM is to change the way delays are associated with government-funded projects and be more time-bound with necessary checks and balances to address the issue. *(Academics, KI -1 and KI-13).* However, this has not been fully effective as a community action group respondent from Coimbatore stated: “We *are three years into the proposal, and they were appointed only 6 months ago, and they were also full of complaints “(KI-12).* This indicates that in spite of the SPV mode instituted for fast-tracking projects, the process is still very slow in some cities.

The urban development strategies that are proposed in Indian cities are generally regarded as sporadic, and furthermore, delays in implementation mean that it sometimes takes more than the designated twenty years, identified as the master plan period. In the case of Coimbatore, the delay in finalising the revised master plan itself is considered a major hurdle to planned urban growth in the city. This was a constant theme in the interview of all informants from Coimbatore, who was unaware of the exact status of the finalisation of the master plan. While this delay can be attributed to a number of reasons which will be further elaborated, the delays in preparing the land use planning policy documents are not always the fault of the planning authority. They are sometimes caused by changes in policy effected by the state government as in the case of Chennai. The current master plan for Chennai is expected to operate until 2026. However, the changing of the geographical area of the city in 2018 (refer to section 7.3.2) effectively means that the master plan must be reviewed again to accommodate the additional area *(Academic, KI-3).* This resonates with findings in section 3.4.1 in chapter three on the high reliance on the master plan mechanism, which either stalls planned growth or leads to unregulated growth. Another less debated, yet a valid contributor to delays is lack of experience or working knowledge on large-scale projects *(KI-13),* which also contributes to the delay. This leads to the comment from Chennai based urban designer *(KI-5)*, who is involved with the smart city projects on a limited capacity: “all *people concerned with the mission still grappling…. everyone is still grappling around it”.*

Lack of leadership

Though leadership can have shared attributes with political mechanisms, it is often a quality that is missing within the city building environment in Indian cities. Due to the traditional top-down planning approach and the power distance index mentioned in section 7.5.1, city administrators and planners are often reliant on orders from superiors. While it is difficult to work against this established structure, leadership is a crucial element to deliver a smart city. As a Chennai urban designer stated, “*these things cities taking the leadership role, city trying to garner more partnership with private companies”*. One of the Chennai academics *(KI-1)* identified that strong leadership would help in overcoming some of the delays discussed earlier with implementing urban projects. Likewise, a key informant identified strong leadership with entrepreneurship and finance skills as a necessity to deliver smart city projects *(KI-1).* In Coimbatore, some of the interviewees *(Urban designer KI-11, Community action group KI-12)* raised the issue of an unsuitable candidate appointed as smart cities CEO for the Special Purpose Vehicle, without necessary the vetting process. The CEO was removed further to strong opposition from the community and NGOs. This led to delays in launching the smart city projects in the city by several months. Contrary to this situation, these respondents conveyed that cities like Bhubaneshwar and Surat were found to have done their due diligence in appointing the CEO of the Special Purpose Vehicle (SPV) in their respective cities.

Top-down approach

An aspect of planning structure in Indian cities that were highly criticised is the high-top down approach adopted for the implementation of urban development projects. Kundu (2019) postulates that the lack of effective decentralisation due to India’s political structure is the reason for failure to provide basic services and infrastructure.
An academic (*KI-7)* observed that even though the smart cities program is trying to change this trend, it still persists. The respondent identified that the central government is adopting a more prescriptive approach instead of an advisory and monitoring role. The criticism goes on as “*the guideline, the framework, the decision on the*

components, decision on the priorities, then including the consultants, everything is decided by the Government of India. So, the state government has only a minimal role only in monitoring the projects …… that is against the principle of sustainable development. Sustainable development advocates grassroots democratic process, a bottom-up approach" (*KI-7)*. Another academic (KI-2) also endorsed this viewpoint that failure to engage grass-root level participation has led to poor project outcomes. Administrators like the smart city official of Chennai *(KI-6)* acknowledged that the devolution of powers to local government is still not fully functional in Indian cities. The respondent identified this as a contrasting case to some of the smart cities' around the world, where the mayor of the local government has more administrative power.

Need for transparency

When it comes to transparency, a number of respondents cited lack or total absence of transparency in the governance set up. An urban designer based in Chennai *(KI-5)* was critical of the lack of transparency when it came to information on the consultants involved in developing the various smart cities, as the detail about appointed consultants is not available in the public domain. An overview of the proposal documents and annexures of both Chennai and Coimbatore did not reveal the consultancy firms involved in designing and making the proposals. According to the respondent, this limits his ability to contact the consultant for any query or engage in any form of healthy debate regarding the proposal. This highlights the limitations in the transparency of the existing system Given that once the proposals were finalised, there were no avenues provided for either the community or the stakeholders to engage, The same concern was raised by an academic (*KI-7)* who mentioned that he was unable to find out whom the contractors engaged, where the estimated cost, time frame for completion of the materials used etc. for the various projects etc. Though there are systems in place, it is not clear if they are being followed by all cities identified in the mission. Likewise, the tender documents prepared are not evident in all aspects, given that it is the first time such an initiative has happened in India. The professional stated that as this is a new domain for everyone concerned, there is a state of limbo, and the process has been highly delayed in at least a few cities like Chennai *(KI-5).*

Coordination between departments and Red tape

A key-informant *(Community action group, KI-13)* from Coimbatore indicated how the lack of coordination between different departments is seen as one of the primary causes of delays in decision making. The instance discussed in this case was when the management of water bodies in the city was shifted from the Public Works Department (PWD) that was under the Central government's jurisdiction to the city corporation, without the sharing of all resources. This lack of co-ordination issue was also raised by the Chennai smart city official *(KI-6), who* identified that works like up-grading of roads could involve multiple agencies, overseeing different utility arrangements. To quote his words *"to leave a stone from here to there, it takes an incredible amount of coordination and letter writing and file movement*". Therefore, coordination is required for a range of issues like shifting the lines (plumbing/water/sewage/electricity) or any other equipment like electrical boxes, as week as agreement on design and technology, proposed coordination of timelines, and finally, sharing expenditure. Another area where a high level of coordination is required is in implementing a comprehensive public transport system *(Real estate developer, KI-14).* However, the different departments at all levels of the government are often regarded as working in silos rather than working in convergence *(Real estate developer, KI-8).* Similar feedback that the overall approach to the mission is flawed in the way that the various departments and stakeholders involved are still working in silos was expressed by a Chennai based urban designer. *(KI-5)*

Political mechanism

Like most cites elsewhere in the world, planning is regarded as mired with the political system in Indian cities *(KI-01).* A few respondents *(KI-01,02 and 04)* also expressed concern on the need for a symbiotic political relationship of centre-state governments. They expressed that when this is disrupted, it dramatically affects the progress of projects. Therefore, strong leadership is needed that could work with the constraints and still deliver a good outcome. Especially in the case of Tamil Nadu, the death of the incumbent Chief Minister of Tamil Nadu in December 2016 caused chaos and confusion in the state over a period of time. This period coincided with the selection of several cities in Tamil Nadu for smart city development and therefore caused delays in the mission's progress. In Chennai and Coimbatore, this caused a stalemate. Another point highlighted was the absence of an elected council in the local government, especially in Tamil Nadu, contributing to delays in the SCM implementation *(KI-03).* Likewise, the introduction of the goods and services tax in mid-2017 in India caused a delay in the tendering activities for the projects *(KI-06).* These actions caused by the political mechanism at the central and state level, have significantly impacted urban development projects in India, even though they are beyond the scope of planners and administrators.

Corruption

Several interviewees *(KI-06, KI-07, KI-12, KI-13)* expressed their concern on corruption malpractices that significantly inhibit progress in Indian cities. One of the areas where corruption is more prominent is during the appointment of contractors after the tender process. Contractors who are well connected with politicians are found to be favoured for awarding jobs, which in turn through underhand dealings, payback favour money to politicians. The contractors would cut corners to reduce the money spent, thereby leading to sub-standard and or less than optimum projects. One of the key informants felt that there should be more accountability and transparency in smart city projects to overcome these issues (*Community action group, KI-12*).

Based on the above feedback received from the respondents, the data for barriers to governance has been collated and represented in a graphical view for Chennai and Coimbatore, respectively (see Figures 8.3 and 8.4).From the charts presented, it can be observed that most of the issues were common to both cities. The respondents in both cities mentioned issues related to the political mechanisms, especially in the state of Tamil Nadu, during the time of the interview. One piece of feedback that stands out is that the top-down approach is not considered as a barrier in Coimbatore. It was evident that most respondents were happy to receive funding from the Central government. This is possible because Chennai, being the capital city of the state and one of the largest nationwide, has received a lot more infrastructure over the years. However, Coimbatore does not receive the same amount of funding, and so the funding through SCM is considered a good prospect for the city.

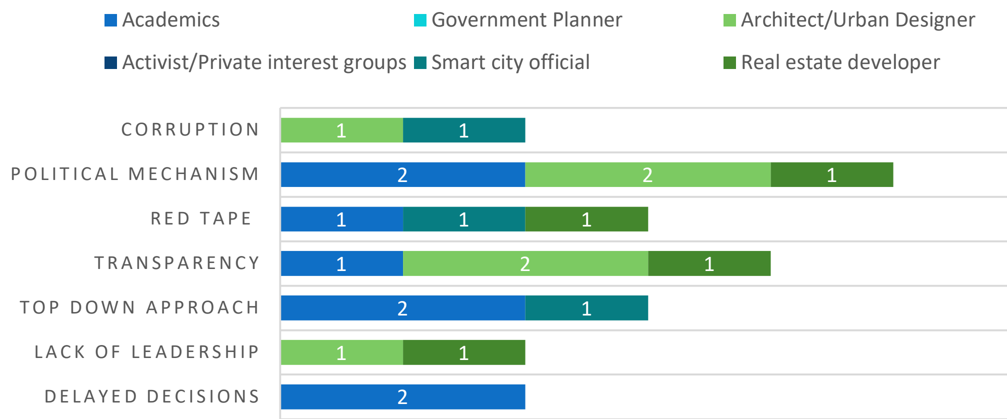

Figure 8. 3: Barriers to Governance in Chennai

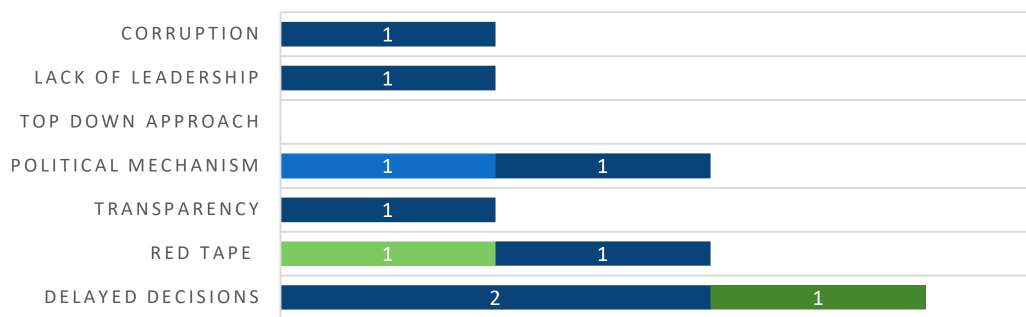

Figure 8. 4: Barriers to Governance in Coimbatore

Based on the above two charts, Figure 8.5 collates the main barriers to governance identified from both cities, presented in descending order of opinions received. While the issues within this dimension are multiple, some of the issues could be addressed by a common approach. For instance, delay in decision making and lack of leadership can be both addressed by identifying and promoting strong leadership within the civic system in Indian cities. Likewise, a collaborative approach would help to overcome a top-heavy approach to a more balanced middle point, where grass root levels are more engaged in the city building process. Similarly, a collaborative approach would also lead to greater transparency, not just with the authorities and the community, but also at the interdepartmental level. To fully achieve this level of co-operation, a conducive political structure would help, thereby reducing red tape in the process, and again contributing to reducing delays.

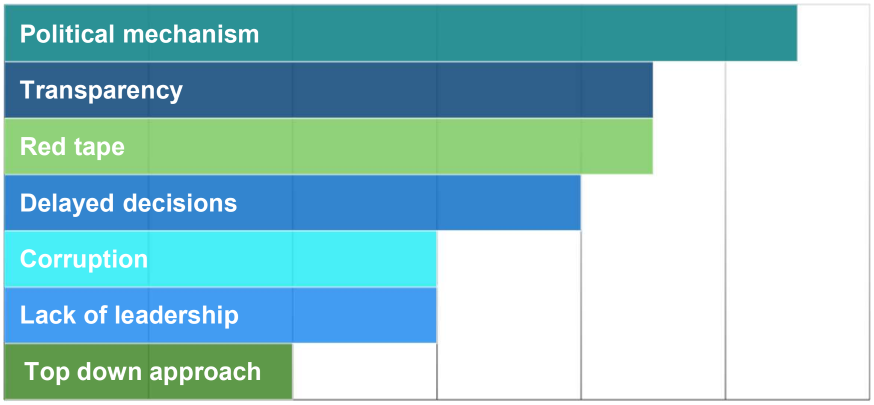

Figure 8. 5: Barriers to Governance in Indian cities

8.4.2 Barriers to Smart Economy

Some of the key themes that emerged from the qualitative data in relation to the economic perspective of smart cities in India are discussed in this section.

Reliance on market forces

One key informant *(Academic, KI-01)* was critical of the evolutionary basis of land use planning in Indian cities that leaves much of the development to market forces. This results in an unregulated growth and a reactive planning body that waits for the city to shape itself and then intervenes at a later stage in the process. This observation also resonates with Chennai's case of allowing developers to promote projects along with water bodies (see section 7.3.4 d). Due to the lack of strong policy measures to restrict development near coastal zones and water bodies, private developers are left to exploit the situation for economic benefits. Also, in Chennai, the CMDA has not made any strategic identification of future growth areas for the city in the last decade (Kabirdoss, 2019) . For a large metropolitan city like Chennai, this has left the onus totally with the private market to keep up with the city's growing demands. As highlighted in section 7.3.4.d, the case of the OMR area is one of the developments in Chennai where real estate developers took hold of the growth pattern. Much of the 45km stretch the road which was once an outbound route to the UNESCO tourist destination of Mahabalipuram. became the address for major IT players, both global and local. Within a span of few years Narain et al., (2014) state that the real estate demand in OMR prompted increased land prices in the once peri-urban area of the city, both for commercial and residential purposes, thereby causing a shift to the centre of the city. Similar feedbacks were not projected by respondents from Coimbatore, though it could still be attributed in its case. The city has the second-largest software export centre in the state next to Chennai, and therefore has a high demand for real estate. The delay in the preparation of the Master plan for the urban areas means that much of the city development is left to the market mechanism. Though this point was raised by only one respondent, it is a crucial issue causing delays in the planning and the lack of direction causing economic implications in the city. The high reliance on market forces is also prevalent in other cities like Bengaluru (Angotti, 2013), where these forces dominate the shaping of the city.

Revenue generation

Property taxes are the primary mode of income for most cities in India. For instance, the income and expenditure statement of the Chennai corporation for 2017-18 reveals property tax as the primary revenue generator (Greater Chennai Corporation, 2018). Other sources include rental income from land and properties, professional taxation charges for individuals, registration and license charges, fines, certificate issue fees, advertising tax revenue etc. Grants and government contributions make up the remaining part of the expense requirement. The Chennai corporation-initiated efforts in 2018 to conduct drone mapping to identify property boundaries more accurately and follow up on property tax defaulters. The real estate developer from Chennai (*KI-08*) and smart city official (*KI-10*) from Coimbatore viewed that the proposed cycle sharing facilities in both cities could be suitable sources of continuous revenue. Likewise, additional revenue is expected to be generated from advertisements on the cycles. Though this is an opportunity for smart cities, it is unclear whether the above claims were made with proper cost-benefit analysis on the expected incomes, or if they were purely speculative. Reports suggest that the Coimbatore cycle sharing project has been unsuccessful due to vandalization and theft of the cycles (Selvam, 2019). While Chennai's cycle sharing is relatively successful from initial reports, Coimbatore's failure has prompted Trichy, another city in Tamil Nadu, to withdraw its smart city proposal.

Attracting investments

One of the key challenges in Indian cities is that they do not have an integrated system built to attract investments into city infrastructure projects. Coupled with ineffective decentralisation, this causes high reliance on central and state governments; this makes the city and municipal governments to falter in this aspect. Large metropolitan cities like Chennai have ways of attracting Corporate Social Responsibility funds from large corporations, towards achieving some of the smart city goals (*Smart city official, KI-06)*. The Smart cities official of Chennai highlighted that by having SCM as an umbrella project, they were able to attract and divert funds for various development needs in the city. In 2014, the Government of India enacted the Corporate Social Responsibility (CSR) law, making it obligations for large businesses and multinational companies to spend 2 % of their profit on projects that address social problems. However, there is apprehension surrounding the real benefits that arise out of the CSR initiatives as the political intervention is seen to direct companies towards projects that are favoured by the politicians or the incumbent government (Kansal et al., 2019). Another key informant *(KI-08)* indicated that in order to attract investments, the creditworthiness of the city government is an important consideration. Municipal bonds are also seen as another avenue for increasing revenue for project implementation. Smaller cities may, therefore, find it challenging to meet this criterion *(KI-08).*

Some key informants *(Academic KI-01, Real estate developer KI-08)* view the mission as an opportunity for increased private sector involvement in city building. The view is "*we don't have a lot of participation from the private sector, so how to woo the private sector to come and participate in the development of these solutions, developments of these projects being identified under the smart city of each of the cities* ".Larger metropolitan cities have many avenues to engage and take advantage of private sector involvement in the city building process, but in the case of smaller cities, this engagement has to be learned and developed, and the SCM provides a platform to build this process.

Funding

Funding for urban development projects is a complex issue, as one Chennai academic *(KI-01)* identified. The displacement of funds from various departments and government agencies is not always synchronised to meet the needs of a specific project. Several interviewees *(KI-04, KI-12, KI-13, K-14)* raised concerns that the smart cities project may stall due to insufficient funds. This concern is more pronounced in case of Coimbatore than Chennai. The Central government funds will have to be met with equal contribution from state and city governments. As indicated earlier, the efforts to raise funds which are dependent on the creditworthiness of the city and attract investments from industry and the private sector are also reliant on the city's experience in such mechanism. The funding of SCM is highly dependent on all three primary agencies, namely, the Central government, state government and the local government's capacity to improve revenue streams and attract investments.

Based on the above feedback received from the respondents, the data for barriers to the economy is collated and represented in a graphical view for Chennai and Coimbatore, respectively (see Figure 8.6 and 8.7).

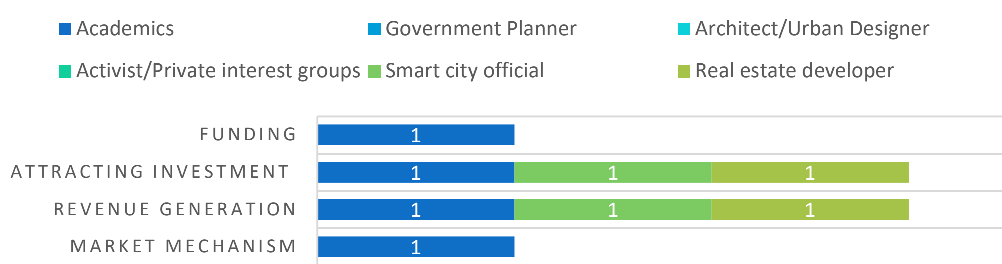

Figure 8. 6: Barriers to Economy in Chennai

Figure 8. 7: Barriers to Economy in Coimbatore

Based on the above two charts, Figure 8.8 synthesises the main barriers to smart economy identified from both cities, presented in the descending order of opinions received. Revenue generation and attracting investments are evident weaknesses in Indian cities, especially in small to medium cities that do not have the experience in attracting such investments. However, for smart cities revenue maximisation from all possible sources and cost optimization in operations will help in improving revenue streams. Likewise, having a potential growth environment will encourage investors, both local and global, to invest in the city, thereby driving its economy forward. Efficient planning can shift the market-dominated growth to market-oriented growth in Indian cities. The planning and policy provisions must be efficient and at the same time, support the creativity of the market forces.

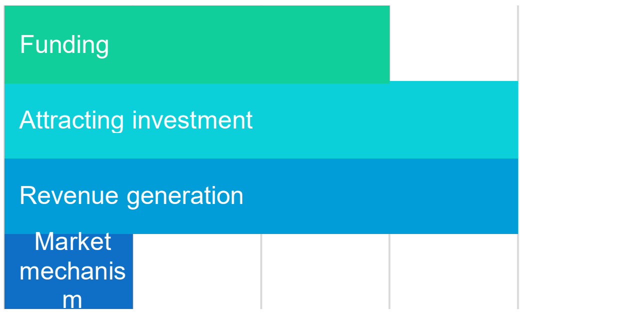

Figure 8. 8: Barriers to Smart Economy in Indian cities

8.4.3 Barriers to Smart Mobility

Some of the key themes that emerged from the qualitative data in relation to the mobility perspective of smart cities in India are discussed in this section.

Traffic management

As indicated in section 3.2, traffic congestion is a massive issue in major Indian cities and is beginning to have an impact on second-tier cities too. As indicated in section 7.3, a lack of clear distinction between different road uses creates a *contest* for space between motorists, cyclists and pedestrians, which adds to the congestion levels. A common sight in most Indian cities to have all these three users occupying narrow roads in addition to sharing them with hawkers on carts. A key informant from Chennai (*Smart city official, KI-06*) states that when it comes to traffic congestion at a particular junction, the immediate response from most consultants to build a flyover. However, he firmly believes that traffic congestion does not necessarily happen due to shortage of road space at that junction, but due to other possible factors like availability of buses, bus routes, metro rail connections, and common ticketing. Common ticketing between bus and metro rail would improve the efficiency and ease of operations not just for the transport companies, but for the commuters too. This, he identifies as the crucial function that is missing to integrate the different transport modes.

Integrated transport planning

Flexible transport options in major centres of a city that are well integrated and highly accessible are considered as necessary for successful mobility (*Academic, KI-02*). Therefore, the integration of different modes of transport is essential in increasing public patronage of alternative modes of transport to foster less reliance on private vehicles. This is found to be extremely important in T Nagar, Chennai, due to the high %age of commercial and retail facilities in the area. The T. Nagar area is considered by many respondents as a well-linked centre with a bus terminus, suburban train network and the newly built metro stations all servicing the area (*Academic, KI-02, Smart city official, KI-06).* However, the different modes have to be integrated and synced to improve patronage and thereby reduce congestion caused by private motorists.

An academic *(KI-07)* noted that Chennai has a relatively low share of public transport with only 29 % of trips by bus and 5 % by trains. Comparatively, Mumbai is estimated to have a 50 % share of public transport and Kolkata almost 70 %. Therefore, the integration of public transport is crucial in improving ridership in Chennai. The number of private vehicles is increasing year by year. The Chennai smart city official (*KI-06)* believes that integration of the networks will result in higher ridership as witnessed in Bengaluru city. The academic from Chennai (*KI-07*) also commented that even though the city has a reasonably well-established public transport infrastructure, the different modes act as standalone facilities without integration. He highlighted on the fact that the Chennai Unified Metropolitan Transport Authority (CUMTA) Act of 2010, was not under operation by the time of the interview. The state government passed the notification in January 2019, after several years delay. The Act will institute a separate body headed by the Chief Urban Planner (Transport) of CMDA. The ten different agencies, under various government departments, which are involved in the management of transport and traffic in Chennai, will be bought together into a single monitoring and implementation body. The other roles of CUMTA will include preparing and promoting a mass transit, integrated urban transport policy and a universal travel card (Express News Service, 2019).

While Chennai has multi-modal travel arrangements, the case of Coimbatore is drastically different. The bus is the only form of established public transport available in the city other than autorickshaws and taxis. Coimbatore has been stressing the need for establishing a metro rail for several years *(KI-09, KI-11, KI-12, KI-13, KI-14*). Many respondents indicated the need for the metro rail and were concerned with the continued delay in meeting this deficiency. The state government announced the metro rail project for Coimbatore in 2017; the feasibility study was undertaken in 2019, with the study completed only in November 2019 (Subburaj, 2019). A few respondents *(Academic, KI-07, Real estate developer KI-14)* mentioned that comprehensive public transport planning is required to meet the future demands of both Chennai and Coimbatore. The delays in instituting CUMTA in Chennai and the metro rail delays have caused significant challenges in the mobility potential of the two cities.

Walking and cycling facilities

Walking is identified by many respondents as directly connected to improving quality of life (*Academic, KI-02*). The need to have safety and security aspects and protection against climate is seen as directly impacting walking. Coimbatore and Chennai have both proposed cycling and walking as one of the core objectives of their SCM. A number of key informants (*Academic, KI-09, Smart city official, K10*) believed that due to factors like the compactness of Coimbatore's layout, land availability along the lake edges and comfortable climatic conditions, the cycling corridor will be a more successful initiative in Coimbatore compared to Chennai. Another respondent believed that in addition to the infrastructure measures, other initiatives such as weekend marathons, cycling challenges and similar events should be conducted to encourage people to use the space more effectively (*Urban designer, KI-11*).

Chennai smart city official (*KI-06*) identified the potential of pedestrian projects, "*even with a mediocre footpath, the increase in pedestrian traffic is unbelievable"*. He said that based on his observations on one of the busiest cities in Chennai, there was a considerable increase in the number of users after widening the footpaths in a particular stretch. Chennai was also the first city in India to enact a non-motorised transport policy in 2014 (Lopez, 2019; Gautham, 2019). *KI-06* further stated that at least in Chennai, the discussion about footpaths happened whereas. In many Indian cities, footpaths meant for pedestrians are often used for parking two-wheelers or even riding on them. Also, in addition to becoming service facilities, these footpaths, are encroached on by advertisement displays and roadside street vendors. This highly reduces the space available for walking, as mentioned in the last section. In other places, poor quality of work, broken surfaces and insufficient width render the footpaths unusable (see Figure 7.10), as referred to in section 7.3.4.d. In tier 2 cities like Coimbatore, barring the main streets, there is even a complete absence of footpaths in the majority of the streets, with the street's edges forming open stormwater drains and sewage drains in some areas.

As highlighted in the section on economic barriers, it is important to carefully consider the failure of the cycle sharing pilot in Coimbatore. Without having the necessary infrastructure that supports cycling, like dedicated paths, safe parking facilities and an integrated transport network that supports multi-modal access, such projects can face challenges. As cycle sharing is one of the most popular initiatives among the smart city proposals, a careful long-term strategy to implement necessary provisions for cycling is required for the future success of such initiatives.

Road safety

Road safety is not a smart city indicator identified in Cohen's (2014) wheel or by Giffinger et al. (2007) and team. Likewise, road safety was also not raised as a major in the qualitative interviews conducted, except by two Chennai academics *(KI-02 and KI-07)* who commented on the need for pedestrian safety while planning walking tracks. However, in the Indian context, the issue of road safety has a far-reaching role. and is especially relevant, when disregard of traffic lights is a significant national issue. India has one of the world's highest road fatalities, and a large proportion of this is due to pedestrians, cyclists and motorised two-wheeled vehicle riders, all disrespecting rules (Mohan et al., 2015). The lack of a clear distinction between different uses and non-adherence to rules by both motorists and pedestrians exacerbates the issue. Planning and design should create this distinct segregation of these activities should become integral in the city street, thereby limiting the number of accidents. While researching on the use of technology to enhance the urban experience in Beijing, Fu (2013) looked at three study areas, namely, a pedestrian bridge, a public square and a subway hub in three different locations of the city. The study included encouraging citizens to use the pedestrian bridge and on discouraging "Chinese style of road crossing by jaywalking", by depositing reward points on the public transport cards of the pedestrians. The possibility of issuing transportation cards to citizens and incentivising adherence to road safety is a strategy that Indian cities could also follow as part of the SCM.

Based on the above feedback received from the respondents, the data for barriers to mobility is collated and represented in a graphical view for Chennai and Coimbatore, respectively (see Figures 8.9 and 8.10).

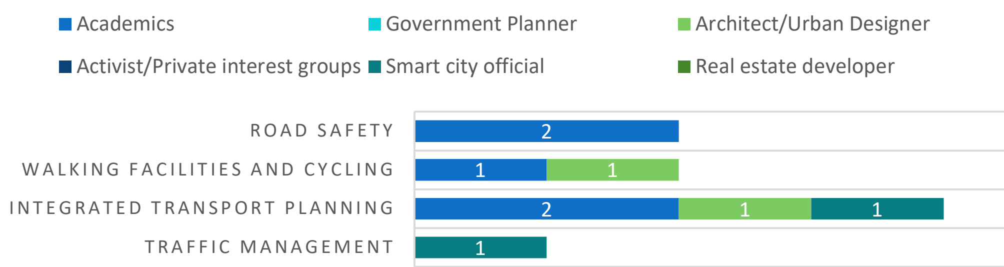

Figure 8.9: Barriers to Mobility in Chennai

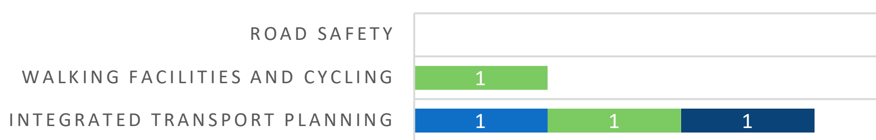

Figure 8. 9: Barriers to Mobility in Coimbatore

From the above two charts, Figure 8.11 synthesises the main barriers to smart mobility identified from both cities, presented in descending order of opinions received. Macro-level planning of the city region that ties strategic growth and integration of transport infrastructure will help to overcome the lack of integration highlighted. This integration, along with providing better provisions for non-motorised transport, will help address some of the mobility concerns in the smart cities.

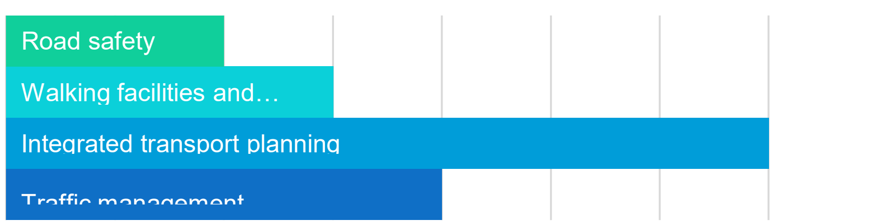

Figure 8. 10: Barriers to Smart Mobility in Indian cities

8.4.4 Barriers to Smart Living

Some of the key themes that emerged from the qualitative data in relation to the living perspective of smart cities in India are discussed in this section.

Civic sense

A lack of civic sense is seen as a significant impediment in both using and maintaining the urban space. Respondents from Chennai *(Academic, KI-03 and Urban designer, KI-05)* found this issue to affect urban quality. The urban planner from Chennai *(KI-03)* indicated that the issue is partly owing to population pressure. Similarly, the Chennai based urban designer *(KI-05)* felt that people do not value the work carried out. For instance, he indicated that it is common for many in the community to park a two-wheeler on a newly constructed footpath. As highlighted in section 7.3.4.d, the widened footpaths are sometimes regarded as extensions of roads and some regard it as an extension of their premises. It is also a common sight to find commercial, construction and other retail activities spilling over into the public space, and often with a sense of entitlement (see Figure 7.10). Features like bollards and metal railings laid in public areas like the side of the road or on the median strip are often stolen. The cycle sharing system is facing a similar case of vandalism in Coimbatore, as discussed in section 8.4.3. While it is difficult to control the behaviour of the community as a whole, efforts like awareness-raising, education and establishing neighbourhood watch groups could help in overcoming some of these issues.

Shortage of recreational facilities

A lack of recreational facilities was highly evident from the discussion with respondents from Coimbatore. This did not come out prominently in the interviews with Chennai respondents. The need for recreational facilities in Coimbatore was indicated by several participants *(Academic, KI-09, Smart city official, KI-10, Urban designer, KI-11, Community action group, KI-13*). The SCM proposal for Coimbatore, which involves establishing pedestrian, cycling and walking connections between the eight lakes, is seen as an opportunity to address this issue. Facilities like boating, bird watching and outdoor natural areas around the lakes are potential elements in the area based SCM for the enjoyment of the community. Singanallur lake, one of the eight lakes, is home to several birds, freshwater turtles and flora. However, as indicated in section 7.4.4, the growth of water hyacinths every year due to the poor quality of lake water is seen as an area of concern by some respondents, which could spoil the lake's potential as a recreational destination.

In Chennai, most often the quality of the space provided is the concern rather than its availability. Two respondents from Coimbatore *(Academic, KI-09 and Community action group, KI-13)* remarked that the Marina Beach in Chennai fulfils the need for recreational space in Chennai, highlighting the lack of such recreational spaces in Coimbatore. As Coimbatore is a commercial and entrepreneurial city, the facilities for businesses are more readily available. For instance, the Codissia Trade Fair complex (see Figure 8.12) with an area of 160,000 square kilometre, is one of Tamil Nadu's largest trade fair and exhibition complexes. However, with the city being a non-capital, the social infrastructure investment is found to be lacking. The city itself offers very few avenues for entertainment within the city. There are only three large-format shopping centres, namely, Brookfield Multiplex in the central areas of the city, Fun Republic and Prozone Mall. With Coimbatore having much more suitable climatic conditions than Chennai for outdoor activities, the provision of recreational facilities in the SCM would enhance the quality of life.

Figure 8. 11 : Codissia Trade Fair Complex, Coimbatore

Source: Codissia website

Informal settlements

One respondent (KI-02) indicated that the core agenda behind the SCM is to achieve a better quality of life. Around 65 million people are living in informal settlements in India as per the last Census data in 2011, with a growth rate of 25% from 2010 (Census of India, 2011). A number of smart cities among the first set of twenty cities have proposed redevelopment of areas with informal settlements. Ahmedabad has proposed redevelopment of slums with an area of 75 acres and improving the housing conditions, as one of its primary agendas. Jabalpur has also indicated slum redevelopment while Coimbatore planned to relocate the informal settlements along the banks of the eight lakes. An academic from Chennai (KI-07) was highly critical of the approach towards slum dwellers, particularly in Tamil Nadu. The respondent noted that in Chennai, during the construction of the metro rail along the rivers in Chennai, the rehabilitation of the slum dwellers was done without proper consultation with them He states that:

> *for example, one dwelling unit, tenement unit costs 2 lakhs. It is given to the slum dwellers at a price of INR 50,000 which could be paid over a period of 15 years. So, it is almost next to nothing. So that being the case what happens is if somebody pays INR 25,000 in lumpsum they happily give it to them, of course unofficially, it could not be sold, there could be no transaction for 5 years. So, they are prepared to take, both parties, and the buyer is prepared to take a risk. So, after 5 years.*
>
> *most of them are defaulters, they won't pay even that small amount whereas the housing board, if anybody defaults payment for the housing board, immediately the housing board will serve a notice, they even cancel the allotment, but a similar action could not be taken, it is completely absent here, because of the vote bank politics and this is how it is happening. This is why more and more slums are created, and we could not realise the objective of clearing the slums and one reason is no participation. At no stage, the slum dwellers or consultant, not even informed, not to talk of consultation, so the rehabilitation schemes are bad examples.*

The slum dwellers in India, in terms of their rights to the city, are often regarded as non-citizens. As their tenements are found mostly on '*poramboke*' lands (a term in the Tamil language to indicate land belonging to the government), that are on riverbanks or coastal areas, the slum dwellers are the worst affected during natural disasters and calamities. Also, close to 13 % of the urban population still defecate in the open, and 22 % of the households have no access to toilets (Census of India, 2011). Most times, it is the urban poor who live in these appalling circumstances. In Dharavi, Asia's largest slum there is only one toilet for every 900 persons, and so people are left to utilise riverbanks, parks, railway tracks and playgrounds, which led to the movement called "Right to Pee." This leaves a growing divide between the aspirations of middle-class

India for a cleaner city and the needs of the urban poor to meet their bodily needs (Kumar, 2017).

Several cities in the global south also face a similar predicament, like in the case of Chinese cities where the urban 'hukou' system prevents them from obtaining their right to the city (Chandrasekar et al., 2016). Provision of affordable housing with due consultation process could resolve this issue. Otherwise, it is quite possible that a similar situation might arise in other cities too. This also brings to focus the importance of community participation and inclusivity in planning.

Based on the above feedback received from the respondents, the data for barriers to mobility is collated and represented in a graphical view for Chennai and Coimbatore, respectively (see Figures 8.13 and 8.14).

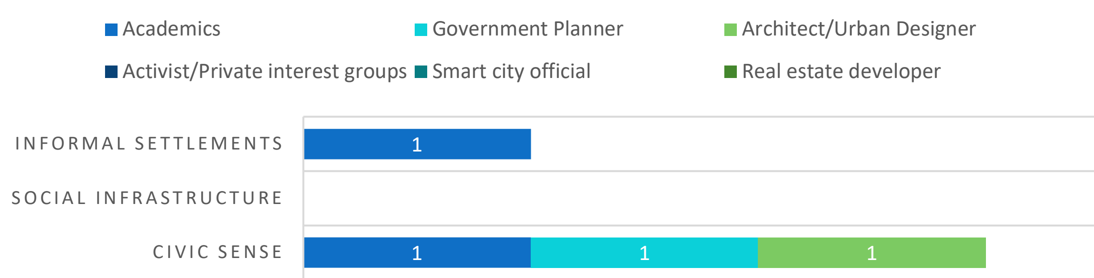

Figure 8. 12: Barriers to Living in Chennai

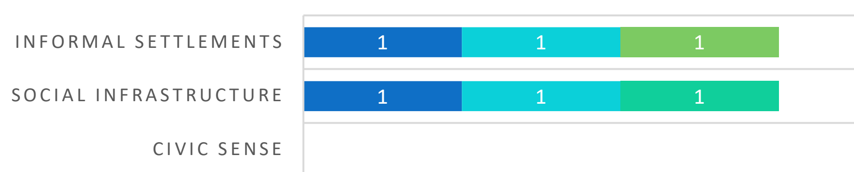

Figure 8. 13: Barriers to Living in Coimbatore

Based on the above two charts, Figure 8.11 synthesises the main barriers to smart living identified from both cities, presented in the descending order of opinions received. It is interesting to note that a lack of civic sense is not seen as a major impediment in Coimbatore; however, it is mentioned by at least three respondents in Chennai. As commented by the urban planner from Chennai *(KI-03)*, smaller cities in Tamil Nadu might have a higher sense of keeping their cities and neighbourhoods clean. Similarly, provision for affordable housing, establishing social infrastructure, especially in second-tier cities, and encouraging a sense of pride among citizens are keys to smart living in India's smart cities.

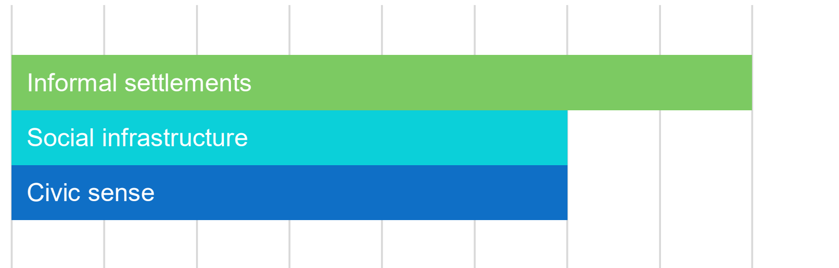

Figure 8. 14: Barriers to Smart Living in Indian cities

8.4.5 Barriers to Smart People

Some of the key themes that emerged from the qualitative data in relation to the mobility perspective of smart cities in India are discussed in this section.

Skill shortage

Recruiting skilled professionals and secondly retaining them are two issues that came out strongly in the discussions. With recruiting people, there are distinctive differences in this issue between the two cities. In the case of Chennai, CMDA, the main city planning body, has a number of town planners in various roles, mainly in the development assessment section, granting approvals. The CMDA website (www.cmdachennai.gov.in) lists master plan unit, area plans unit, road and rail unit, area development unit, construction wing, and enforcement cell as the main areas of work. In total, the department website mentions six chief planners, six senior planners, and twenty-two deputy planners working in the different departments along with five civil engineers (as of February 2020). There are no architects or urban designers listed with the CMDA on the website. However, during the interview, the CMDA planner (KI-03) mentioned that one architect cum planner was recruited in 2017 to assist in the development process. Though the number of planners employed (Kabirdoss, 2019) and the absence of other professionals like urban designers and planners can be contested, the department has planners carrying out the main planning roles. Contrastingly in the case of Coimbatore and many other second-tier cities, the planning departments at the municipal level lack qualified personnel. The duties of a planning officer are often carried out by a civil engineer or even a sanitary health officer. As noted by an academic in Chennai (KI-02):

> "*invariably, the major problem in the implementation is the inadequacy of the planning staff at the implementation end. That is a major problem if you see most of these municipalities the town planning functions/powers are all... even now in some of the distant municipality it is carried out by the sanitary inspector. There is no town planning officer, the sanitary health officer or the sanitary inspector discharges the function of a town planning officer. So, I think even today ten years back also it was the same thing. So, there is an acute shortage of manpower and more specifically trained manpower with the knowledge of planning is not there in the local bodies".*

The deputy planner working with the DTCP in Coimbatore *(KI-15*) highlights the structural changes in the governance system that has resulted in this situation. Firstly, the qualification requirements for the Chief Planner positions in DTCP for large municipal corporations like Coimbatore are based mainly on seniority. So, the person appointed as the chief planner is at most times, either a civil engineer or even mechanical engineer. The second issue is the non-existence of junior planner roles in the municipal corporation, where it is replaced with junior engineer designation. The personnel recruited for the junior engineer position are trained for a few weeks to execute the works of a planner/civil engineer/sanitary officer. The training is carried out either in the Tamil Nadu Institute of Urban Studies in Coimbatore, School of Architecture and Planning in Anna University, Chennai, or at School of Planning and Architecture in the University of Delhi. The key-informant observes that planning takes a backward step in the process.

Another aspect of this issue is retaining the selected skilled personnel in the government, especially within the same department. One informant *(Academic, KI-01)* cited the instance of how a member trained in remote sensing had to be transferred to a different department after a few years, as his current department will not have a position in line with his experience. The academic identified that the transfer of trained employees between different departments leads to hiccups in the implementation of projects. The transfer would often be necessitated due to not having a position for the employee in that specific department when he moved to a senior position. This situation leads to moving the employee to a new department to fulfil his seniority position. KI-01 observed that such a case would not arise in a corporate set up where a new position would be set up to retaining the skilled worker in the same department. Skill shortage and training personnel evolved into one of the most prominent issues in the interview data analysis.

Stakeholder engagement

The SCM guideline document states engagement with the community and stakeholders as a key criterion in the mission implementation. A stakeholder meeting was conducted by the implementing agency, which is the city government in most cases. According to the respondents, the meetings were held with representatives, including other government departments, planning agencies, community action groups, and academics. However, the level of engagement was highly criticised by several stakeholders who were involved in the process. The government planner from Chennai *(KI-03)* noted the reduced role of CMDA in the smart city process. While representation from CMDA was there in the preliminary meetings, the expertise of CMDA was not utilised completely. Also, he commented that "*the entire team planning wing was not there; the technical input from planning expertise is not there. Presently the Chennai corporation is the overall managing agency for smart city Chennai; wherein there is no planning wing. There is no permanent town planning wing, or not even a planner is present in the Chennai Corporation*. This viewpoint resonates with the view of a Chennai academic *(KI-01)* who mentioned the lack of utilisation of experience and knowledge within the governance system.

An academic (*KI-02)* stated that even within the current setup, excluding the SCM, the interaction between different stakeholders is not effective collaboration. An example was cited in the case of Chennai, where although the interaction between the government and academic institutions and also interaction between the government and police occurs when it comes to planning related issues, the interaction between the primary planning body, CMDA, and academic institutions and the police does not occur. Even though monthly meetings between the various government organisations occur, thorough discussions on the issues do not come about due to the absence of some of the agencies most times and due to the lack of a common agenda. The discussions do not happen within a basic framework and the agenda, if any, is micro-level rather than encompassing a broader approach. This lack of agenda results in the different stakeholders ending up proposing action points that are relevant to their own departmental requirements. Because of this, a silo centric engagement exists between the stakeholders which stop the CMDA from either drawing lessons from research or from getting police support, for instance, to gain better planning control in terms of addressing unauthorised construction or restoring the stipulated width of a pedestrian path from encroachments. The lack of political powers for the planning body in addition to reduced engagement with critical stakeholders reduces the effectiveness of the planning body in restricting unauthorised construction, which, according to the respondent, makes up 20-30 % of the structures *(KI-02).*

Participatory planning

Das and Dahiya (2019) discuss that compared to other countries representing the global south, India and Indonesia have a relatively stable system of civic group participation. Even though the increased efforts to include public participation is evident; in India, the data and information received from key informants. provides a conflicting picture Participatory planning in the development of urban space is one of the highly criticised areas on the functioning of city governments. Within the domain of participatory planning, community means the users of the city and other stakeholders such as academics, industry, private consultants, and other government departments, are all key players in the city building process. The flaws in stakeholder participation in SCM have already been discussed; community engagement and role in the process is discussed here. An academic respondent *(KI-01)* indicated that although the legal provisions within the administration mechanism mandate consultations, it does not necessarily indicate how it has to be conducted. As mentioned before, the smart city mission document identifies public participation and engagement as a core criterion in the implementation of the mission. In the case of Chennai, for instance, the initial stakeholder meetings were held before submission of the first round of the city challenge competition. An online survey was also conducted to select the area-based proposal, and T. Nagar was identified as the selected area-based development, The SCM proposal of Chennai indicates an outreach to 967,850 people, through offline and online engagement. The offline engagement was made through polling booths, suggestion boxes and consultations at zonal offices, direct consultation program, radio program, mass SMS and print media. The online engagement was through the My Gov website of the Indian government, city corporation website, and other social media platforms like Twitter, Facebook and YouTube. However, the document does not indicate how many numbers of people took part in the survey. T Nagar was identified as a winner of both online and offline platforms.

Even though, The Chennai Smart City (@ ChennaiSC) twitter handle created in September 2015, around the commencement of smart city challenge, had only seven tweets and followed by 223 followers. The twitter account, which is not active anymore, has one of the tweets (18 Nov 2015) mentioning the citizen engagement as 30 lakhs (3 million). The final tweet from the page, on the same day, states that "*Majority of the outreach was offline as the citizens found it difficult to use the online portals*". Likewise, the Chennai Smart Cities Limited's official website identifies citizen engagement as necessary in the smart city process. However, the graphic displayed in the section lists out Bhopal, another city's outreach numbers (see Figure 8.16). (The graphic was accessed from the link https://cscl.co.in/citizen-engagement accessed on 20 December 2019.)

Figure 8. 15 : Community engagement data of Bhopal presented in Chennai Smart city website

Community engagement was undoubtedly carried out in the SCM process. However, the above example brings out the question of the quality of the engagement process. Two Chennai based urban design professionals *(KI-4, KI-05)* who were actively working with the city corporation indicated that they were not aware of any of the above engagement activities. One of the respondents *(KI-04) said:* "*I feel like it is not meaningful participation because at the end of the day it seems like the consultants, in conjunction with the implementation agency is really the one pushing the agenda for a particular city and how seriously they take people's opinion on it, seems to very dubious".* Similarly, another comment was*" In Chennai particularly nobody knew what was going into the proposal, it was only after the document was released that I am looking at it".* The respondents also mentioned that most people were not aware of the smart cities proposals at that point in time when the public outreach was happening. This also aligns with the researcher's observation when informally spoken to the general community members. The immediate response was that they were ignorant of the mission, or the conversation took a cynical angle on the mission's success. Additionally, many informants noted that the plans for T Nagar were prepared a few years before the smart cities plan and that the mission provided a means to achieve the outcome. This raises questions as to whether the participatory process was carried forth with efficiency or if it was treated as one more mandatory requirement to be met.

The urban designer *(KI-04)* was highly critical of the said engagement with the community, at least in the case of Chennai Smart City works. According to that expert, there was not much awareness among the public about the projects, even among their professional circle, on how the mission was being carried out. The initial stages of the mission did not have much clarity, and the cited that even as an urban design professional, they had to struggle to comprehend the actual intent. Their opinion was that projects were chosen where some study had already been completed, and projects that had been left out in previous missions were pooled together and renamed under the mission. Even though the mission has a dedicated website with proposals put up in the public domain and citizen participation was encouraged in logo design, visioning exercise, etc., participation was not wholly meaningful. There were also claims that the consultants appointed were the ones pushing their agenda was morphed as citizen feedback *(KI-04).*

An academic key informant *(KI-01)* highlighted how past experiences shape the way the planning body handles community engagement. He cited the example of Chennai's second master plan, which was delayed by several years due to filing of a writ petition in the Court. He commented that the *"first master plan launched ... somebody went to the court and then another five years was missed out ... so somehow, we had to push the second master plan... the participatory mechanism was shortened*. ''This, according to him, was the reason for the shortened participatory mechanism and lack of meaningful engagement. Therefore, in most instances, minimum requirements are met, and the plans pushed forward with the attitude that "*at least instead of nothing at least this much has happened is what is our satisfaction*...". Though the SCM has increased its outreach, there is still much improvement needed to have meaningful engagement. The lack of understanding of the right to the city combined with lack of inherent participatory mechanism built into the process means that it is still practised as another checkbox to be ticked, rather than a real, concerted effort to actively seek and incorporate community views into the process of city shaping.

To consider a balanced viewpoint, the Chennai smart city official indicated the challenges in obtaining community feedback. He said that "*talking public participation is easy*; *we are not a village; we are a massive city. Public participation is not easy unless you have systems in place to give feedback" (KI-06).* This is a valid argument based on the absence of an established participatory mechanism built into the planning system. However, the key question that arises out of this is, if there is a serious political will to establish such a system. Architect and activist, Das, (2015) raise the critical view that urban planning and design has to be understood as ''claiming the right to the city'' and should be regarded equally as other democratic provisions facilitated by law. The architect regards planning and design as democratic tools for manifesting social change and preventing exclusivity in the public domain. In India, the city building process is shaped by the policies set out by the prevailing government, policymakers, and private agencies. The community is often engaged casually or cynically after the plans are formulated and finalised, rather than during the plan-making process. The other main challenge is the public approach to planning, with the perception that knowledge is exclusive, which prevents them from taking active participation.

Based on the above feedback received from the respondents, the data for barriers to people is collated and represented in a graphical view for Chennai and Coimbatore, respectively (see Figures 8.17 and 8.18).

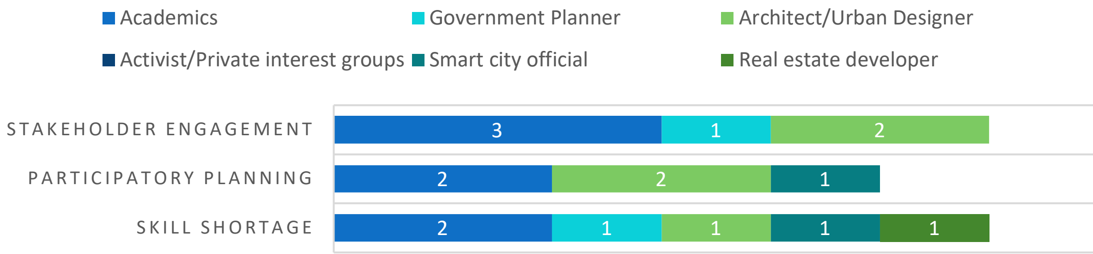

Figure 8. 16: Barriers to People in Chennai

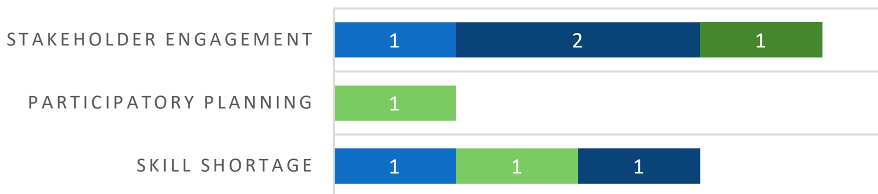

Figure 8. 17: Barriers to People in Coimbatore

Based on the above two charts, Figure 8.18 synthesises the main barriers to smart living identified from both cities, presented in the descending order of opinions received. Even though the priorities are set out right in the mission, the total omission of expertise by planning bodies like CMDA and DTCP is not a progressive step as it disregards years of combined experience by both the planning bodies. The inherent issue of red tape discussed in the governance section also prevents proper engagement between the stakeholders at an interdepartmental level. Even though procedural requirements have to be met, it should not prevent meaningful engagement between stakeholders and community who are integral to the city building process.

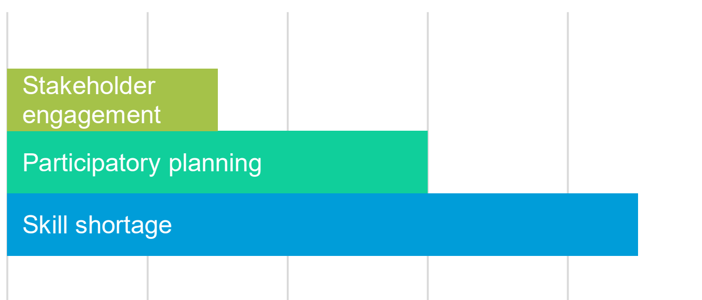

Figure 8. 18: Barriers to Smart People in Indian cities

8.4.6 Barriers to Smart Environment

Some of the key themes that emerged from the qualitative data in relation to the environment perspective of smart cities in India are discussed in this section.

Lack of a holistic approach

Planning of cities in India is mostly viewed in isolation and infrastructure projects are not always planned within the Master Plan regulations of the city. Metro rail projects predominantly funded by the central government are looked at in isolation from say, bus terminal proposals funded by the state government. Even though feasibility studies are prepared for large scale public projects before the start of the design phase, they sometimes do not consider all influencing factors. City building is a highly evolutionary process that could take several decades to complete. Yet without a holistic approach to the city development process that aligns with the overall city vision, the long-term future of the city cannot be ascertained. Many respondents identified the absence of a holistic approach in Indian city planning.

Most of the experts viewed that thus far most urban development projects in India have mostly been dealt with on a piecemeal basis or as vertically segregated projects, lacking an integrated approach with a broader horizontal equation to it *(Academics KI-1,KI-2 and KI-7*). Another expert *(KI-01)* pointed out that traditionally the planning process is both sporadic and highly delayed in India and most times would take up more than 20 years which is the generally stipulated Master Plan period. This is one of the possible reasons for lack of cohesion and broad perspective and the usual tunnel vision adopted in the planning and development of cities. The deficiency in adopting a holistic approach sometimes permeates to a whole new level. Chennai based urban design professional *(KI-05)* who is involved with the SCM project in a limited capacity, stated that lack of holistic approach is a big challenge that would affect the effectiveness of the area-based proposals. To quote the interviewee, the works are proposed to ‘’*make it look pretty for some time”* rather than looking into the problem in hand wholly.

Another urban designer *(KI-04)* from Chennai offered a different viewpoint to this situation. She stated that

I am only postulating that what is stopping them from doing that holistic vision for the cities that they have a certain budgetary requirement, under which they have to allocate projects that all sort of tally up at the end on a tally sheet. So a non-motorised transport project gets so much money, an ICT project gets so much money, and the division of that is you know, how the pie gets divided seems to be one large governing, and that really is a closing statement of most of the smart city proposals, is that it ends with this list of projects with numbers assigned to each of them . Now I think that this sort of becomes counter-productive to the original exercise because at the end of the day you can make up all of this flowery stuff but it really just comes down to implementing projects

The lack of integration and holistic approach is not just reflected at the city level, but even at the level of projects. Such as in the lack of integration of utilities like trunk infrastructure and knowledge sharing between different government departments. In most Indian cities it is a common sight to have a newly re-laid road being dug up, by one or the other service providers like water and sewerage department or stormwater drainage services. This might reflect the red tape that prevents intergovernmental information sharing and leadership. It is also the failure of the primary agency, namely, either the main roads and transport department or the city corporation to have contacted the other relevant service agencies before undertaking the work. In the words of are Chennai smart city official (KI-06), "*we lack in a holistic approach looking at...There is no institution to do that".* In the current digital age, the urban digital strategies devised for a city should align with the overall strategic planning of the city, for a far greater sense of purpose (Alizadeh 2017). There is no doubt that a holistic planning approach is instrumental in the success of a smart city.

Peri-urban growth pressure

As highlighted earlier, city planning strategies in India are sporadic and without a clear, focussed strategic outline. Few of the key informants drive the need for strategic intervention beyond the current reliance on development control rules in Indian cities, as development rules are limited in their role to provide future growth directions (*KI-01)*. One of the major issues that spring out of this situation is peri-urban growth pressure. The Chennai government planner *(KI-03)* indicated the lack of a regional level policy had been the reason for real estate development just beyond the boundary of the city. He cited the case of Chennai, where huge developments have sprung up in areas designated for agricultural use. As the CMDA does not have jurisdictional authority over those areas, it limits any intervention by the planning body. Combined with lack of coordination between the Directorate of Town and Country Planning body (DTCP) in charge of those areas, and the CMDA, regulating development in the peri-urban areas of the city is an enormous challenge. Even as early as 2003, Dahiya identified thirty-four peri-urban areas around Chennai that lacked the necessary institutional cover, resources, services connections and administrative capacity, leading to an unhealthy physical environment. Most of the areas identified in the researcher's work are under the jurisdiction of CMA, and some of the issues identified by Dahiya (2003) are still prevalent in these former peri-urban areas. Developments along the OMR stretch, and the adjoining residential areas discussed in section 7.3.4, for instance, do not have underground sewage networks and still reliant on septic tanks for waste disposal. Another issue highlighted (KI-02) is that "*the second master plan was prepared, as a good document, as a strategy it was good, but neither the government nor the CMDA had the necessary power, authority, legal framework, and protection to implement it with the tooth*". Without a supportive governance mechanism, the peri-urban pressure will continue to persist.

Lack of Regional policy

The enforcement of land use planning policies is an area which elicited differing views. While academic informants *(KI-01 and KI-09)* from Chennai and Coimbatore felt that enforcement of the policies and rules is not stringent enough, the CMDA official *(KI-03)* felt that only due to employment of stringent measures, has CMDA been successful in implementing successful adherence to the development control rules in Chennai. However, the same official admitted that although this enforcement is possible within the metropolitan boundary, he felt that the same could not be said about the peri-urban areas of the city and noted how this continually puts pressure on the city development. According to the Chennai city planner, the town panchayats around Chennai can grant approval only for two-storied structures. Due to loopholes in the development rules, few landowners do land pooling to obtain approval and end up building large scale gated community residential developments on the outskirts of the city, which would be approved by the town/village panchayat. However, the local body, in this case, will not have the provisions or funding to meet the infrastructure needs of the new developments. Though there is awareness of the need to prepare regional level policy in Tamil Nadu, there appear to be several delays. In the words of the planner "*We are supposed to prepare a regional plan for the whole region and followed by a master plan because we need to implement it as it is being followed in the metropolitan area. So Master plan for the whole area will also be prepared, dividing the whole area into two-three zones.*

Pollution

As discussed in chapters three and seven, air, water and solid waste are three major forms of pollution affecting most Indian cities, not just the large metropolitan cities. As Chennai has a very unhealthy air quality situation (see Figure 7.11), understandably, it was mentioned by two respondents in the interviews. An academic (*KI-02)* referred to the multi-nuclei model of the city (see Figure 7.6) as one of the reasons for air pollution. The land-use pattern established has led to the positioning of major industrial areas in the northern part of the city with the residential areas concentrated in the south and western parts of the city. This has resulted in greater trip lengths, travel demand, increased fuel consumption, pollution and accidents. Chennai smart city official (KI-06) commented observed that the SCM and the central government's liveability indicators have set a good precedent for looking into important issues like pollution. He further stated that although sensors and technology are needed to measure the parameters associated with pollution, it is also not all about the digital tools, and therefore other strategies will also be employed in Chennai's smart cities.

The overall comfort level in most Indian cities is highly endangered by this extraordinary level of pollution, urban heat island effect (UHI) and the resultant reduction in thermal comfort. Typically, a city in a warm, humid zone should be carefully designed to remove stagnant air mass so that it does not add up to the UHI, which, if coupled with the humidity, will attract pollutants in the air and thereby drastically reduce the air quality and invariably the urban experience (De and Mukherjee, 2014). Therefore, strategically placed tall buildings could enhance the wind flow by creating strong wind currents. Likewise, tall buildings in a dense neighbourhood could impede the same wind flow. Similarly, higher Floor Area Ratio (FAR) with lower plot coverage of buildings in important locations will improve airflow and urban comfort. The same approach might have the opposite effect in cold regions and windy cities (Givoni, 1998).

Design guidelines such as designing a cluster of tall buildings at strategic points will improve the heat build-up and prevent heat loss in these cases. It is, therefore, crucial that urban design guidelines should be contextualised and appropriately framed, keeping in mind the urban physics of the location (De and Mukherjee, 2014).

Coimbatore has also proposed and as of 2017, already installed pollution monitoring equipment in thirty locations to measure carbon monoxide and carbon dioxide (Smart city official KI-10). However, a community action group representative (KI-12) expressed that using sensors is only a reactive approach, and without addressing the main issue, it is of no relevance. Vellalore garbage yard, the major landfill yard in Coimbatore was given as an example, where fitting sensors will not solve the problem of excessive dumping. An Urban designer based in Coimbatore (KI-11) indicated that the pollution level in the lakes has impacted water birds and the fish ecosystem and believes that SCM proposal will bring back the birds and revive the fishing activities in the lake.

Based on the above feedback received from the respondents, the data for barriers to the environment is collated and represented in a graphical view for Chennai and Coimbatore, respectively (see Figure 8.20 and 8.21). The common elements and overall lessons in relation to governance will be discussed in section 8.3.

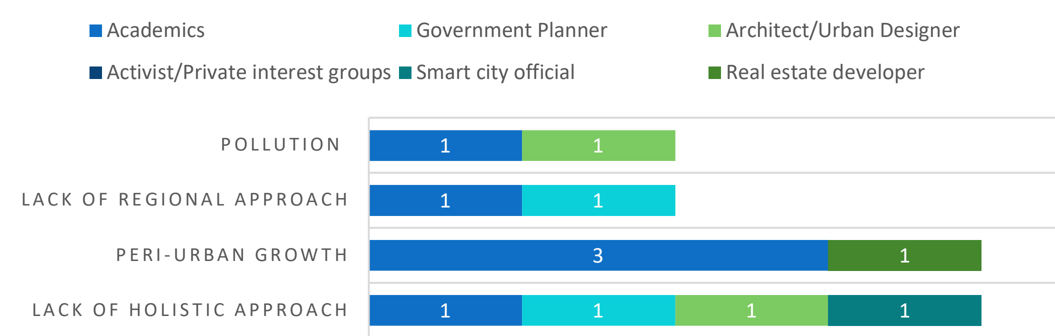

Figure 8. 19: Barriers to Environment in Chennai

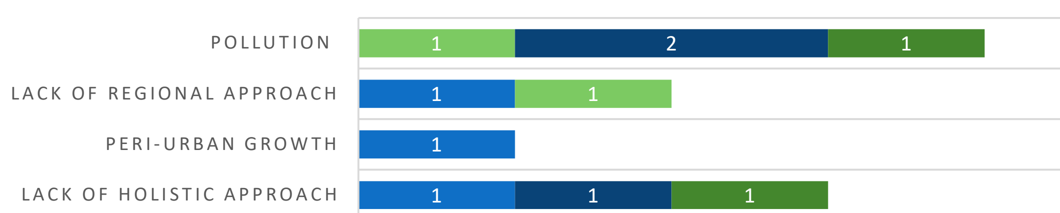

Figure 8. 20: Barriers to Environment in Coimbatore

An 'early-stage' smart city is one that has primarily integrated IT and construction industries to provide combined services. Advanced cities would apply multiple components of the technologies for greater integration (De Jong et al., 2015). All the major issues that came out of the qualitative analysis are of high significance to Indian cities. While issues such as lack of regional and, holistic approach and peri-urban pressures are often not visibly related to their impact on the quality of urban life, and they do have adverse effects. Likewise, air pollution and solid waste management are two pressing issues in most Indian cities. The former primarily caused by increasing private vehicle ownership and the latter by non-segregation of waste at source and its poor management.

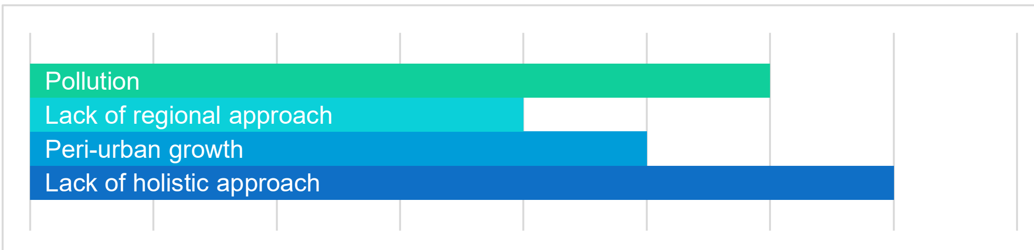

Figure 8. 21: Barriers to Smart Environment in Indian cities

8.4.7 Barriers and Opportunities to Urban Design

Smart cities are viewed by some (Luque-Ayala and Marvin, 2015) as a derivative of smart urbanism that uses the language of 'smartness' in reinventing contemporary cities. India's smart cities mission deploys a similar strategy in revitalising cities that are failing to maintain pace with the population and economic growth. In a way, the smartness parameter is used by the Indian government to drive the urbanism model. As one academic *(KI-01)* expressed when it comes to city image "*the relationship between space and sense of belonging to the place is age-old.... for any human race... that being the case we should put in some more effort on making our cities visible, acceptable, enjoyable*". The SCM proposals mandating urban design practices were established in chapter six, and yet the lack of urban design disciplinary focus in Indian cities was identified. Similarly, the ethnographic analysis of the two cities revealed both cities performing very low on the majority of the six urban design qualities assessed. The interview data also confirmed the lack of urban design focus in Indian cities that correlates with the low score gained. The key barriers that emerged from the qualitative data in relation to the urban design perspective of smart cities in India are discussed in this section.

Understanding the role of urban design towards city building

Sensitivity towards understanding the role of urban design and its value in the development process is the essential first step for Indian cities. One key informant (Academic, KI-01) stated that when it comes to urban design among government officials "*sensitivity itself is not there with the officers...because they would not have that background*". The absence of urban design focus in Indian cities highlights the lack of recognition for the discipline. Chennai based architect cum urban designer *(KI-04)* expressed this lack of appreciation towards the discipline in general. In particular, he stated that the role of an urban design professional as part of the city planning team could be instrumental in bringing together the different disciplines. In his personal experience, the respondent accepted that overall, the situation has improved in the last decade. Earlier, in the case of large-scale urban projects, the RFP's (Request for Proposals) issued by the government to appoint private consultants, did not list urban designer as a required part of the team. The respondent noted that although an urban designer is still not considered as the team lead, they are beginning to be accepted as an integral part of the team *(Urban designer, KI-04).* Some of the comments from respondents that relate to the lack of sensitivity towards urban design are reproduced here

> *"it (urban design) is still in a very nascent, hidden stage in Chennai..."*
>
> Academic (KI-01)

> *"Frankly speaking, there is no concept of urban design in India as such. It's all first-time method. Somebody says come on do it. There is no application mind and then understanding the culture and then history of the area in coming with the design."*
>
> *"urban design is in a very, very primitive stage in the Indian context."*
>
> Urban Designer (KI-11)

> *"before urban design, you have to ask, why there hasn't been much emphasis on planning in India, so you have to start with that, urban design is one of the instruments you use in planning, it's not a discipline, planning is the discipline …..urban design needs the condition of planning and of new imaginations to thrive in the way you are imagining it. So that's the reason urban design hasn't been in discussion."*
>
> Architect and Academic (KI-16)

> *“I have been meeting lot of this urban design professionals, and everywhere they were asking, what is the importance to urban design given by various cities?”*
>
> Real estate developer (KI-08)

The discussions with various key-informants validate the earlier findings from this research on the lack of awareness towards urban design among city administrators in India.

Encouraging urban design practice and professionals

Beyond the recognition of the urban design discipline, a conducive environment and encouragement are also required. A Chennai based urban designer *(KI-05)* stated that there is not much scope within the mission itself in providing opportunities to urban designers who genuinely want to collaborate in the projects. The criticism was based on the RFPs advertised by the various city governments in which the eligibility criteria is set very high such that many eager consultants do not qualify. Therefore, the tender ends up being awarded to the same set of consultants again and again. However, the mission does permit consortiums among private consultants. Most times, the lead consultant in the consortium is a real estate developer or multinational corporations. The shortage of consultants working for the one hundred cities was highlighted in chapter six. As indicated, only thirty-seven consultants were found to be involved in the initial proposal stage for preparing proposals for 88 cities. The proposal thus made during the city challenge cannot be altered, once approved by the high- power committee. In the case of Chennai, Jones Lang Lasalle, an international real estate player, prepared the smart city submission. They engaged external urban design consultants as sub-consultants to work on the project. Similarly, other international consulting firms like KPMG, McKinsey, Mott MacDonald and CRISIL were involved in the SCM proposal preparations (PTI, 2017). The selection criteria system adopted for the engagement of these consultants is also not clear. However, the involvement of these influential international consultants limits the role of local consultancies.

A possible reason for lack of involvement by local consultants could be as indicated by the government planner from Chennai *(KI-03).* The planner stated that professionals like architects are not keen on working in government establishments like CMDA and prefer private practice. He explained that this is possible because independence in decision making and freedom to create is absent in a government set up. So far, no urban design specialist has been recruited by the CMDA. Likewise, architects and urban designers sometimes hesitate in undertake government projects, especially with city governments. From the personal experiences of this researcher, the observation by the city planner is valid. A respondent *(KI-05)* identifies that the important reason for the reluctance of urban design consultants. City governments like Chennai, when calling for urban projects, release tenders with a fixed payment system irrespective of the value of the project. The designer found that the fee structure finalised by the city corporation was too low even to operate, let alone make a profit. In addition, the pre-established strict payment cycle inhibits the consultants' cash-flow and makes the feasibility of the work difficult. City corporations do not make advance payments, and therefore, consultants have almost to finance the project until the halfway stage when the first payment is released. The urban designer also highlighted that sometimes the payments do not come through promptly, for any of the consultants to follow up for payment collection continually. The comment below by a Chennai based real estate developer sums up the state of urban designers in Indian cities. The lack of support in the governance system for the good design of cities is evident, and it is left to private consultants to bring out

> *"It is very difficult in India to really implement this whatever you want to do in the urban design perspective because they don't care about urban design and the approach is also not there because you don't have professionals whereas as consultants we can engage urban designers."*

Real estate developer (KI-08)

Another crucial element in encouraging urban design practice is the education component. As highlighted before, the shortage of planning and design professionals necessitates focusing on this component. Urban design education in most countries is studied at the post-graduation level and to limited capacity at the undergraduate level. In countries like Australia, the eligibility for studying urban design is open to a range of disciplines like architecture, landscape architecture, urban planning, town planning, urbanism and geography, thereby attracting students from various backgrounds. However, most architectural and planning schools in India teach urban design as a specialisation of the Master of Architecture program. Therefore, the entry requirements are restricted to students who have done their first degree in either architecture or urban design. Premier institutions in India like CEPT, Ahmedabad and School of Planning and Architecture, New Delhi, which both offer specialised urban design programs, follow these entry requirements. Flexibility in the entry requirements and establishing inter-disciplinary courses would improve the number of design and planning professionals. It could, therefore, address the shortfall in the availability of both planners and urban design professionals, especially in smaller urban centres and towns.

Urban Design Policy

Design control is highly misunderstood and not effectively practised within the context of town planning policy (Paterson ,2012). Town planning policies in Indian cities do not have any provisions for urban design control. Yet in the absence of national urban design policy, countries like India representing the global south should aim to include a minimum set of design guidelines, the city level. The lack of sensitivity towards urban design among city administrators and the reliance on private consultants to deliver urban projects was clear from the earlier discussions. As discussed in section 6.5, countries like Australia, UK and New Zealand have all undertaken research and development of policies and frameworks for promoting good urban design in their respective countries. However, without support at the policy level, the formalisation of the discipline will not happen at the Indian context. A number of respondents expressed similar viewpoints:

> *"They think it is superfluous because there is already a master plan for Chennai, but they should say that it is a value addition to the master plan. It is in no way is going to be a hindrance in implementing the master plan. This sensitization should go into the minds of the administrators and politicians."*
>
> Academic (KI-01)
>
> *"As of now as architects, we do individual building design, and planners are not actually having a major say in the development of towns and cities, they stop with the theoretical framework of planning, master plans, but they are not filtering down to implementation."*
>
> Academic (KI-01)

"We need to sensitize not just the people, but also the officials, authorities, the politicians. Every person has to be sensitized. Every group has to be sensitized about the need for urban design. We should make it such a way that makes it an indisputable component of the overall planning and development. "

Chennai Smart city official (KI-01)

The relevance of an urban design policy framework is well supported by the above feedback. A policy framework will help in an enabling environment for good urban design within the SCM. It would also give the necessary direction for a long-term future of achieving better quality placemaking in Indian cities.

8.5 Conclusion

This chapter has explored the two case study cities of Chennai and Coimbatore, in further detail to discuss the barriers and opportunities identified from the interviews conducted with key-informants of both cities. Using the seven dimensions of smart cities model proposed in chapter five, the interview data were synthesised to understand the barriers and opportunities for smart city implementation in Chennai and Coimbatore. Analysing the interview data using the smart city dimensions helped in gaining a deeper understanding of the smart cities proposals in India. The analysis of the qualitative data revealed several key themes within each dimension. Though several strong opportunities come out of the mission, numerous barriers were also identified. Barriers to governance, people and environmental dimensions relatively outweighed other dimensions. The findings from the interviews helped to validate the findings from the literature review and analysis conducted in the previous chapter of this research. The final chapter of this thesis synthesises the findings from chapters five, six, seven and eight, to present the conceptual model for smart cities in India.

CHAPTER 9

CONCLUSION: URBAN DESIGN PERSPECTIVE FOR INDIA'S SMART CITIES

9.1 Introduction

The final chapter attempts to link the conceptual theory and the empirical evidence presented in the thesis. It summarises the key findings from the research that address the aim of the study and the research questions. The first section synthesis the research findings and presents the results in two segments. The core emphasis of the thesis is to confirm the need for urban design in a smart city, which is discussed as the first segment. The importance of urban design within the smart cities mission of India and a conceptual guideline for achieving this objective is brought out in the second segment. The chapter builds upon the investigations carried out in the previous chapters to formulate the new smart city framework. The second section delivers a set of recommendations based on this research. This chapter addresses the final research question on the required components for a smart city in India is addressed as part of this section. The third section focuses on presenting the significant contributions of this research towards smart cities body of knowledge. The fourth section discusses the limitations of the thesis and the final section elaborates on possible future areas for further research.

9.2 Research findings

The thesis began with the hypothesis based on Kourtit et al.'s, (2012) expression that contemporary smart cities place a high priority on being a 'place of senses' without enough emphasis on the 'sense of place', an essential component in cities. The significance of 'place' based design is therefore lost in a technology-centric smart city. This gap in urban design focus hampers its vision to achieve 'high' quality place outcomes through design. The aim of the present research was to explore the importance of urban design within the context of smart cities transformation in India, with a focus on delivering a conceptual guideline for urban design strategies. The research had four main questions; firstly to understand the role of urban design within the context of a smart city; secondly, to examine the smart city mission of India and to establish to the relevance of urban design within the mission; thirdly, to analyse the effectiveness of smart city proposals on addressing the urban planning problems in Indian cities, and finally to develop a conceptual urban design guiding framework for the smart cities' transformation in India.

Two preliminary objectives were also addressed to gain an understanding of the research gap, and that acted as a propellant to move the study forward. The concept of smart cities was first reviewed identifying the lack of a universal definition. This led led to the recognition of the smart city model as an alternative approach to understand the attributes of a smart city. One of the more significant findings to emerge from this thesis is the recognition of smart cities as a versatile city model, against the various criticisms about the model. Likewise, the place-based design approach was found missing in some well-recognised models. Secondly, the current state of urban planning and design in Indian cities was reviewed to provide a historical context to the study on India's smart cities mission. The lack of research on cities in emerging economies of the global south was also identified as a premise to be explored.

Smart city terminology evokes a sense of technological urban utopia, possibly due to the inclusion of the word 'smart' in it. This is owing to the constant bombardment of the word 'smart' engulfing us in this decade, with the overload of 'smartness' in the form of smartphones, smartwatch, smart homes, smart schools, smart boards, smart speakers, smart fridges, smart washing machines, right down to smart bulbs and more. Naturally, a smart city does sound like a technologically advanced city form, or as a testbed city for experimenting with the cutting-edge innovations and much more, but at a city scale. Therefore, the first challenge was establishing the contributing elements to a smart city or in other words establishing the domain area for the smart cities, given the lack of a universally accepted definition. Clever, bright, intelligent, sharp, and acumen are some of the dictionary meanings for the word 'smart'. The literal meaning of the word creates psychologically high expectations on its performance. Without the overwhelming expectations, a smart city can be a city where all components are designed, constructed or implemented, and managed with logical sense. However, to give a definitive answer on what a smart city is, it is important to consider Townsend's (2013) question that it is not important to know 'what a smart city is', it is actually 'what you want your smart to be?'. The research found the smart city model to be versatile, that adapts to the level of 'smartness' visualised by respective city or nation. Likewise, the literature review identified two research gaps with one being the shortage of research on smart cities in the global south, constituting the need for place-based approach in smart cities, with urban design as a key dimension.

The missing perspective on 'place'' based design in smart cities led the research forward, that helped to develop an enhanced smart city model, as an alternative to the Cohen's smart cities wheel. Integrating urban design, as a unifying and contributing dimension, at the very core of the other six dimensions, the model was drawn similar to a symbolic flower. Past research on smart cities has attributed only the six key dimensions of Economy, Environment, Living, People Governance and Mobility. The crucial element of 'place' that ties all these aspects together, especially the design aspects of this 'place' dimension is missing from the discourse. It could be argued that green urban planning is included as one of the indicators in Cohen's smart city wheel. However, on reviewing the Cohen model indicators (see Annexure-B), urban planning primarily focuses on land use management and using statutory planning control tools. Without urban design focus in smart cities, the aim to achieve a good quality of life through contributing physical environment will remain a remote idea. The contribution of urban design parameters towards place-making in smart cities was established in chapter five. Urban design is often regarded as a peripheral discipline or more of an accessory to architecture and urban planning. While the role of architecture and planning as-built environment disciplines is straight forward, urban design's position within the city building process is questioned by some scholars and practitioners. However, the contribution of urban design, through enabling policy has led to the creation of high-quality places world over, which has addressed the above disagreements. Smart cities model is often criticised for its over-reliance on technology overlays to achieve various outcomes. Therefore, there is a real danger in not recognising the need to create a feeling of 'sense of place' in smart cities, which can only be achieved by designing the city based on good urban design principles.

After establishing the need for the well -designed 'place' approach in smart cities, the study then assessed the implication of the above theory in India's SCM. It was found in chapter 6 that a large portion of the SCM proposals by various cities was focused on urban retrofitting/regeneration/renewal, which was predominantly large-scale urban design projects. Therefore, the research identified that in spite of these proposals, there was a lack or almost complete absence of national and state-level policy guidelines for urban design projects, unlike the case with developed countries. Given the existing planning and infrastructural deficiencies, the almost complete absence of focus towards urban design will be another drawback to the proposed Indian smart cities. This further supports the theoretical finding of the relevance of urban design in smart cities. There has been little or no research attention on urban design that could contribute to a smart city, especially one that is a brownfield site. While greenfield smart cities have more flexibility in their approach, brownfield site projects offer the greatest challenge in integration with existing and new infrastructure and systems. However, urban design has the potential to morph the conflicting areas in this integration.

The third objective was to analyse the effectiveness of smart city proposals on addressing the urban planning problems in Indian cities. This was achieved through case studies on the two cities of Chennai and Coimbatore. The planning deficiencies along with an analysis of the quality of urban spaces was analysed from the gathered data. It was also useful to observe the similarities, barriers and challenges in Chapter 7 and 8, while comparing the two cities with varying size, population and growth patterns. The case studies, along with the key-informant interviews, helped insubstantial understanding on the state of Indian cities and in identifying specific attributes that would contribute to the customised smart city model, specific for Indian cities. The final objective of the research was addressed by developing a conceptual urban design guiding framework for the smart cities' in India, based on the urban design integrated smart cities wheel developed in chapter 5 of the research As indicated earlier, the next two subsections presents the summary of the key research findings.

9.2.1 Urban design perspective for smart cities

Urban development approaches can be of two types namely a comprehensive development approach, wherein an urban renewal project is undertaken citywide or commercial development of an existing urban area or a greenfield or a brownfield area within a city. On the contrary, as Tengbjerg et al.(2014).notes, cellular renewal approach also referred to as partial development, and involves the regeneration of multiple sites within an existing city , that could be either comprehensive work or ad-hoc implementation. Comprehensive development is predominantly significant scale development with a limited constraint that is generally carried out in the peripheral areas of an existing city. Cellular renewal is often small scale with restraining factors due to the development being proposed in existing areas or for increasing densification Smart city proposals in India, executed through area-based development and pan-city strategies is, therefore, more at a cellular renewal level. In this context, it is crucial to consider how to replace, renew and regenerate the parts of the city that are already well integrated into the whole (Landry, 2005), as good examples for future developments. Such cellular renewal projects have the real danger of becoming one-off wonders that may or may not deliver the desired pilot area success story. To prevent this from happening the ideal strategy would be to consider the future of the city as a whole and then proposing the future of the parts. This can only stem from first establishing a holistic vision for the city's future strategic growth direction and then working on the individual areas.

The SCM was a groundbreaking initiative in the Indian context and well-received all-round by several stakeholders. Appreciation for bolstering funding for urban projects, the suddenness of the mission without necessary groundwork prior to the launch is found to be a drawback. Without much background work on policy formulation, establishing standards and guidelines, the city governments were left to rely heavily upon the central government for directive.. This is especially telling when it comes to establishing design guidelines for projects. Not having the in-built capacity for carrying out large scale urban renewal projects, several cities, especially the tier-II cities like Coimbatore had to rely on consultant's skills and knowledge for planning and design of the projects. Especially when a review of the proposal documents revealed the extent to which place-based design solutions were central to the smart cities proposals of most of the cities. The limited capacity and human resource availability for qualified planners and urban designers within the city governments, which are the primary smart city implementation agencies is a problem for the effectiveness of the pilot smart city projects. The lack of urban design integration within the Indian urban planning system also needs to be highlighted, as the planning system provides the framework for the design and the development practices in cities.

Having established in chapter five on the need for urban design's in a smart city, the lack of policy and guidelines on this perspective requires introspection and action. Practitioners and academics both highly recommend the need to have a good urban design policy. The need for attracting investment of transnational and multinational corporations, in an international, competitive market place to has led to a reduction in barriers related to planning and design (Anastasia et al., 1998).

One of the key informants raised the question on which is more important 'utility or aesthetics'? to which this researcher replied that both are important. It is similar to the highly debated topic by architects on whether to choose 'form over function' or 'function over form'. Architect Louis Sullivan conclusively established that form should always follow function, and yet ignoring form would take away the sculptural quality of architecture, regarded as the mother of all arts. Therefore, form and function should not be seen as two factions but two sides of the same coin. Similarly, in cities, both utility and aesthetics are equally important. The quality of the urban space would diminish greatly if only function or utility is seen as the main motive.

9.2.2 Conceptual model for Indian smart cities

Lynch (1981) reproved planners for neglected to formulate a normative basis for planning that could serve as a toolkit. Traditionally, one of the main impediments for creating a foundation theory for professional urban practice is the lack of consensus between different radical groups like deconstructionism, Corbusian modernism, everyday urbanism, New urbanism design theories (Lang, 1994). Moreover, a look back into the postmodern history of planning reveals that what is 'solution' to one generation becomes the 'problem' to the next, like rigid zoning regulations, skyscrapers and modernism's freeways that led to the uncontainable sprawl. The question that needs to be answered is should the current-day planning try to get it right or build something that will be discarded post-2030 and beyond as a failure of the previous generation. Good city form or normative theory should exist together with other planning theories and invigorate planning practice more so than the present state. The planning of the new Indian cities should also set out against these principles i.e., to have a clearly defined planning framework that is backed by a clear vision to take it forward and make India's cities future proof.

Tibbalds (2001) view urban spaces as muddled yet rich as well as a complicated and messy mix of different activities. Therefore, the urban design process should allow room for these different attributes to co-exist by not being too prescriptive to make everything neat and tidy. The various interconnected and interdependent elements forming this complex system should be allowed to interact so that they bring out the qualities in due course of time. To understand the design intent of the urban design of a place, it is crucial to consider its political and economic context (Cuthbert, 2007)

A genuine collaboration between stakeholders has resulted in successful urban design initiatives around the world.

> *"We need to analyse the ingredients that make a successful 'place' and work with them once again … we are now dealing with modern issues that affect the recipe: a changing climate and the need for more people to live in a more humane city environment".*
>
> Ritchie (in Ritchie and Thomas, 2009, p.92)

The above words by Adam Ritchie ring true, even though it was spelt out in a slightly different context. Yet, the need to re analyse the components for successful place making in a technology centric ecosystem, cannot be neglected. On this premises, we revisit Cohen's smart city model (see Figure 2.10) again, based on which the new conceptual smart city model was proposed (see Figure 5.6).

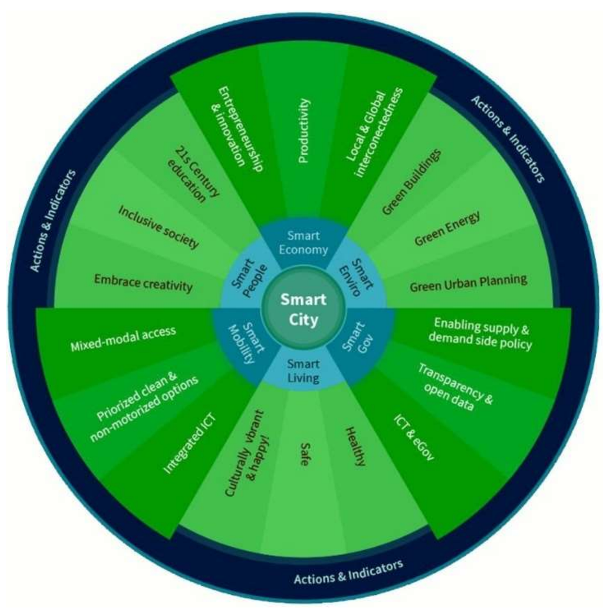

Figure 2.10: Smart City Wheel (Repeated from chapter 2)

Source: Boyd Cohen (2012)

As discussed earlier, the new model has urban design take a central and unifying position , contributing to the six dimensions in a smart city.

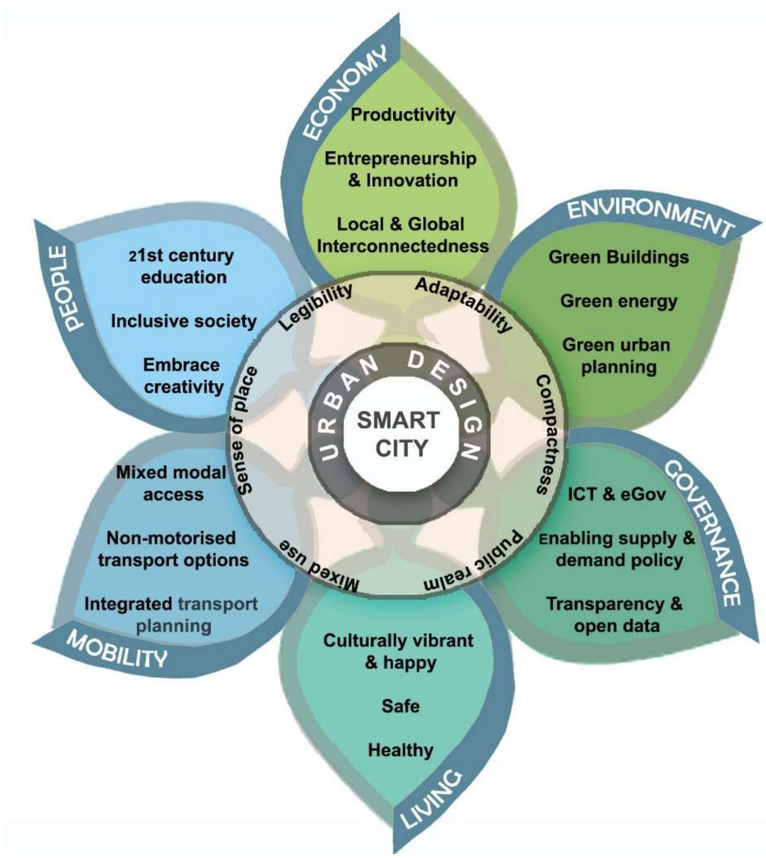

Figure 5. 6: A Proposed theoretical model for smart cities (based on Cohen's wheel) (Repeated from chapter 5)

Further to the development of this conceptual model, the quality of public spaces in Chennai and Coimbatore was assessed in chapter 6 .Provision of green infrastructure, high reliance on master plans for developments, pollution, lack of social infrastructure, traffic congestion and improper methods of solid waste disposal, all emerged as major issues concerning the two cities. Chapter seven was concerned with analysing the key informant interview data on a broader perspective. The analysis involved identifying barriers and challenges in realising the smart city vision, set by the respective cities A number of barriers for each of the six dimensions along with challenges to urban design as a discipline were discussed. The next step involved triangulating all the findings to propose a conceptual smart city model for Indian smart cities, that may be useful to other emerging economies as well.

In order to arrive at the conceptual smart cities model for India, it is required to suggest suitable indicators to address these barriers. The following drawing identifies suitable indicators to address the barriers to India's smart cities, thereby the

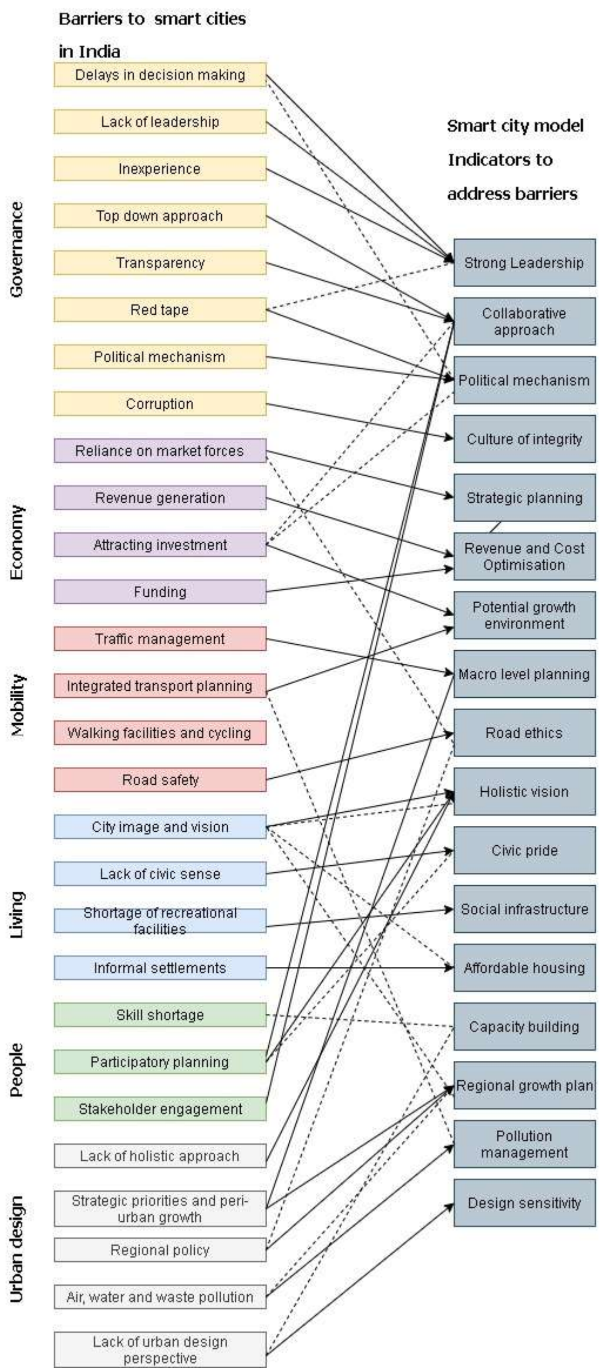

Figure 9. 1: Barriers to smart cities and strategies to smart cities in India

Based on the above analysis (Figure 9.1), a new smart city model including the indicators identified from the research process is proposed. The new model has an additional layer to the existing theoretical smart city model, developed earlier in the research. The design of the model is inspired by the traditional Indian art form called. 'Kolam' or 'Rangoli'. Kolam, is a drawing made using a mix of colour powders in front of one's residence. Kolam is an integral part in the life of India and is considered a form of celebration as well as auspicious. The design is also inspired by the Lotus, the national flower of India. The model thus proposed is flexible as more layers can be added or deleted to form either a symmetrical or asymmetrical outcome. The model can be used as practical tool, not only in Indian cities but similar cities from other emerging economies.

Figure 9. 2: Conceptual Smart Cities model for smart cities in India

9.3 Recommendations

Smart cities are both a promise and a warning in some cases, due to its inclination towards technology-enabled urban revitalisation, masquerading unassailable promises of false utopian city imagery, often boosted by entrepreneurial stakeholders. In the case of Indian cities, the 'big' city imagery as part of the utopian dream often leads to proposals that don't intend to meet the basic city priorities. The politics in the city making process in India often presents the low-hanging fruit as the ideal solution, though not always for long-term benefit. The SCM is, without doubt, a significant milestone for the transformation happening in Indian cities. However, the question remains if the transformation is going to have significant long-term benefits that could impact continuous revitalisation of the city towards a progressive future. The slew of projects proposed by the one hundred cities is varied, to say the least. However, addressing lack of basic city services like 24x7 water supply and electricity, underground sewage network, road up-gradation works, fitting LED streetlights and broadband access networks, is the priority of most cities. On the other hand, and after very long-time, the cities are also experimenting with creating public spaces that are walkable, bicycle-friendly and better connected. Some cities like Chennai are utilising the mission to carry out significant urban revitalisation projects. The tens of smaller cities, other than the three megapolis and five metropolitan cities are all addressing this lack in infrastructure facilities, in particular social infrastructure. Given the nature of the projects, it is important for Indian cities to have a better discussion and action towards the use of urban design. The following key recommendations are made based on this study.

- Indian cities should continue to invest in the city building process, especially the second-tier cities and smaller towns
- Effective devolution of powers to local government is necessary for better city management
- Capacity building, skill development and resource management is crucial for long-term and continued success of the smart city project.
- Setting up national level standards and policy framework for urban design, will provide a conducive environment for good design initiatives
- Engaging indigenous design consultants and utilising expertise of local knowledge will improve collaboration and effectiveness.

9.4 Significance of the research

The contributions of this research are two-fold. Building a new theoretical smart city model with the integration of urban design is the primary theoretical contribution of this research. The proposition of the research was to investigate the role of urban design within the smart city model. It was required to understand the existing definitions and theories on smart cities to address this proposition. Most of the existing theories on smart cities, even though they acknowledge the six areas for development, miss addressing the place component comprehensively. The Smart city wheel developed by Cohen contributed to presenting a succinct and clear model for the smart city concept ,yet, the conceptual smart city wheel developed for this research is more holistic in terms of addressing the lack of 'place 'based design focus. Therefore, the research contributes to the existing smart city body of knowledge in developing an expanded generic model for the smart city, based on the Cohen wheel. This new approach will contribute to the expanding yet evolving smart cities theoretical knowledge. The study is the first comprehensive investigation on understanding the role of urban design, within the domain of a smart city.

The practical implications of the research include the creation of a new conceptual smart city model with urban design at its core. The new model can be applied to Indian cities and also to other cities from other emerging economies. The symbolic flower design of the framework gives greater flexibility in customising according to the specific city vision. The petals can be arranged to include more layers, depending on the complexity of the proposal. The framework created will offer a guideline for city planners, urban designers, smart city managers, administrators, industry bodies, organisations and members of the public who are stakeholders in the city building process. The third significant contribution addresses the general lack of urban design focus in Indian cities. As stated previously, design of public spaces is often implemented as the mere provision of basic amenities and services to serve that space rather than a holistic attempt to deliver a space that offers visual, sensory and pleasure to its users.

9.5 Limitations of the research

The research has several limitations from a methodological perspective. Firstly, the research is looking at the relevance of urban design in smart cities, especially in cities of the global south or emerging economies. The selected case studies are from India and therefore, the guidelines developed even though it may have limited applicability in other countries. However, the integrated smart cities model and the guidelines for Indian cities can be a good starting point for other countries with similar circumstances. While it is expected that the outcome of the study will have a global application for cities with similar context, this aspect cannot be tested. Furthermore, case study cities were selected based on the home state of the researcher in India, to avoid logistical difficulties in commuting to cities at great distances for ethnographic field observations and to overcome language barriers.

In addition to the spatio-temporal limitations of the study include the sampling size chosen for the study. Using two case studies has its limitations, especially when it comes to providing generalised research findings. However, the use of content analysis to analyse the proposals of eighteen other Indian cities to some extent, compensate for this limitation.

9.6 Areas for further research

The thesis analyses a relatively less explored perspective on smart cities and proposes urban design as an additional yet unifying dimension within the smart cities wheel. The research reveals considerable opportunities for future research for further integrating urban design and smart cities, refining the key urban design indicators proposed for achieving well-designed places. Secondly, there is a shortage of research on urban design in an Indian context. More research on this front could trigger more awareness among city governments in India to formulate urban design guidelines that are specific to the context, leading to the creation of high-quality public spaces. Thirdly, there is potential for understanding the inclusion of urban design as part of the planning process at the city level, to create a conducive environment for greater adaptation.

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APPENDICES

Appendix A – Smart City factors and indicators by Giffinger et al. (2007)

	factor	indicator	year	level
Smart Economy	Innovative spirit	R&D expenditure in % of GDP	2003	regional
		Employment rate in knowledge-intensive sectors	2004	regional
		Patent applications per inhabitant	2003	regional
	Entrepreneurship	Self-employment rate	2001	local
		New businesses registered	2001	local
	Economic image & trademarks	Importance as decision-making centre (HQ etc.)	2007	regional
	Productivity	GDP per employed person	2001	local
	Flexibility of labour market	Unemployment rate	2005	regional
		Proportion in part-time employment	2001	local
	International embeddedness	Companies with HQ in the city quoted on national stock market	2001	local
		Air transport of passengers	2003	regional
		Air transport of freight	2003	regional
Smart People	Level of qualification	Importance as knowledge centre (top research centres, top universities etc.)	2007	regional
		Population qualified at levels 5-6 ISCED	2001	local
		Foreign language skills	2005	national
	Affinity to life long learning	Book loans per resident	2001	local
		Participation in life-long-learning in %	2005	regional
		Participation in language courses	2005	national
	Social and ethnic plurality	Share of foreigners	2001	local
		Share of nationals born abroad	2001	local
	Flexibility	Perception of getting a new job	2006	national
	Creativity	Share of people working in creative industries	2002	national
	Cosmopolitanism/ Open-mindedness	Voters turnout at European elections	2001	local
		Immigration-friendly environment (attitude towards immigration)	2006	national
		Knowledge about the EU	2006	national
	Participation in public life	Voters turnout at city elections	2001	local
		Participation in voluntary work	2004	national
Smart Governance	Participation in decision-making	City representatives per resident	2001	local
		Political activity of inhabitants	2004	national
		Importance of politics for inhabitants	2006	national
		Share of female city representatives	2001	local
	Public and social services	Expenditure of the municipal per resident in PPS	2001	local
		Share of children in day care	2001	local
		Satisfaction with quality of schools	2005	national
	Transparent governance	Satisfaction with transparency of bureaucracy	2005	national
		Satisfaction with fight against corruption	2005	national
	factor	indicator	year	level
Smart Mobility	Local accessibility	Public transport network per inhabitant	2001	local
		Satisfaction with access to public transport	2004	national
		Satisfaction with quality of public transport	2004	national
	(Inter-)national accessibility	International accessibility	2001	regional
	Availability of ICT-infrastructure	Computers in households	2006	national
		Broadband internet access in households	2006	national
	Sustainable, innovative and safe transport systems	Green mobility share (non-motorized individual traffic)	2001	local
		Traffic safety	2001	local
		Use of economical cars	2006	national
Smart Environment	Attractivity of natural conditions	Sunshine hours	2001	local
		Green space share	2001	local
	Pollution	Summer smog (Ozon)	2001	local
		Particulate matter	2001	local
		Fatal chronic lower respiratory diseases per inhabitant	2004	regional
	Environmental protection	Individual efforts on protecting nature	2004	national
		Opinion on nature protection	2006	national
	Sustainable resource management	Efficient use of water (use per GDP)	2001	local
		Efficient use of electricity (use per GDP)	2001	local
Smart Living	Cultural facilities	Cinema attendance per inhabitant	2001	local
		Museums visits per inhabitant	2001	local
		Theatre attendance per inhabitant	2001	local
	Health conditions	Life expectancy	2001	local
		Hospital beds per inhabitant	2001	local
		Doctors per inhabitant	2001	local
		Satisfaction with quality of health system	2004	national
	Individual safety	Crime rate	2001	local
		Death rate by assault	2001-03	regional
		Satisfaction with personal safety	2004	national
	Housing quality	Share of housing fulfilling minimal standards	2001	local
		Average living area per inhabitant	2001	local
		Satisfaction with personal housing situation	2004	national
	Education facilities	Students per inhabitant	2001	local
		Satisfaction with access to educational system	2004	national
		Satisfaction with quality of educational system	2004	national
	Touristic attractivity	Importance as tourist location (overnights, sights)	2007	regional
		Overnights per year per resident	2001	local
	Social cohesion	Perception on personal risk of poverty	2006	national
		Poverty rate	2005	national

Appendix B- Smart City indicators by Cohen (2014)

DIMENSION	WORKING AREA	INDICATORS
ENVIRONMENT	Smart Buildings	Sustainability - certified buildings
		Smart buildings
	Resources Management	Energy
		Carbon Footprint
		Air quality
		Waste generation
		Water consumption
	Sustainable urban planning	Climate resilienceplanning
		Density
		Green space per capita
MOBILITY	Efficient Transport	Clean-energy Transport
	Multimodal Access	Public transport
	Technology Infrastructure	Smart cards
		Access to real-time information
GOVERNMENT	Online services	Online procedures
		Electronic Benefits payments
	Infrastructure	Wifi-coverage
		Broadband coverage
		Sensor Coverage
		Integrated health +safety operations
	Open Government	Open Data
		Open Apps
		Privacy
ECONOMY	Entrepreneurship & Innovation	New start ups
		R+D
		Employment levels
		Innovation
	Productivity	GDP per capita
	Local and Global connection	Exports
		International Events Hold
PEOPLE	Inclusion	Internet connected Households
		Smart phone penetration
		Civic engagement
	Education	Secondary Education
		University Education
	Creativity	Foreign-born immigrants
		Urban Living Lab
		Creative industry jobs
LIVING	Culture and well-being	Life conditions
		Gini index
		Quality of life ranking
	Safety	Crime
		Smart crime prevention
	Health	Single health history
		Life expectancy

Appendix C - 100 smart cities in India

No.	Smart city in the order of merit	State/Union Territory
	Round 1 selection - January 2016	
1	Bhubaneswar	Odisha
2	Pune	Maharastra
3	Jaipur	Rajasthan
4	Surat	Gujarat
5	Kochi	Kerala
6	Ahmedabad	Gujarat
7	Jabalpur	Madhya Pradesh
8	Vishakapatnam	Andhra Pradesh
9	Solapur	Maharashtra
10	Davanagere	Karnataka
11	Indore	Madhya Pradesh
12	NDMC	Delhi
13	Coimbatore	Tamil Nadu
14	Kakinada	Andhra Pradesh
15	Belagavi	Karnataka
16	Udaipur	Rajasthan
17	Guwahati	Assam
18	Chennai	Tamil Nadu
19	Ludhiana	Punjab
20	Bhopal	Madhya Pradesh
	Fast track cities round - May 2016	
21	Lucknow	Uttar Pradesh
22	Warangal	Telangana
23	Dharamshala	Himachal Pradesh
24	Chandigarh	Chandigarh
25	Raipur	Chhattisgarh
26	New Town Kolkata	West Bengal
27	Bhagalpur	Bihar
28	Panaji	Goa
29	Port Blair	Andaman & Nicobar Islands
30	Imphal	Manipur
31	Ranchi	Jharkhand
32	Agartala	Tripura
33	Faridabad	Haryana
	Round 2 selection - September 2016	
34	Amritsar	Punjab
35	Kalyan-Dombivalli	Maharashtra
36	Ujjain	Madhya Pradesh
37	Tirupati	Andhra Pradesh
38	Nagpur	Maharashtra
39	Mangaluru	Karnataka
40	Vellore	Tamil Nadu
41	Thane	Maharashtra
42	Gwalior	Madhya Pradesh
43	Agra	Uttar Pradesh
44	Nashik	Maharashtra
45	Rourkela	Odisha
46	Kanpur	Uttar Pradesh
47	Madurai	Tamil Nadu
48	Tumakuru	Karnataka
49	Kota	Rajasthan
50	Thanjavur	Tamil Nadu

No.	Smart city in the order of merit	State/Union Territory
51	Namchi	Sikkim
52	Jalandhar	Punjab
53	Shivamogga	Karnataka
54	Salem	Tamil Nadu
55	Ajmer	Rajasthan
56	Varanasi	Uttar Pradesh
57	Kohima	Nagaland
58	Hubballi-Dharwad	Karnataka
59	Aurangabad	Maharashtra
60	Vadodara	Gujarat
	Round 3 selection - June 2017	
61	Thiruvananthapuram	Kerala
62	Naya Raipur	Chhattisgarh
63	Rajkot	Gujarat
64	Amaravati	Andhra Pradesh
65	Patna	Bihar
66	Karimnagar	Telangana
67	Muzaffarpur	Bihar
68	Puducherry	Puducherry
69	Gandhinagar	Gujarat
70	Srinagar	Jammu & Kashmir
71	Sagar	Madhya Pradesh
72	Karnal	Karnataka
73	Satna	Himachal Pradesh
74	Bengaluru	Uttarakhand
75	Shimla	Tamil Nadu
76	Dehradun	Maharashtra
77	Tiruppur	Tamil Nadu
78	Pimpri Chinchwad	Maharashtra
79	Bilaspur	Chhattisgarh
80	Pasighat	Arunachal Pradesh
81	Jammu	Jammu & Kashmir
82	Dahod	Gujarat
83	Tirunelveli	Tamil Nadu
84	Thoothukudi	Tamil Nadu
85	Tiruchirapalli	Tamil Nadu
86	Jhansi	Uttar Pradesh
87	Aizawl	Mizoram
88	Allahabad	Uttar Pradesh
89	Aligarh	Uttar Pradesh
90	Gangtok	Sikkim
	Round 4 selection - January 2018	
91	Silvassa	Dadra & Nagar Haveli
92	Erode	Tamil Nadu
93	Diu	Daman & Diu
94	Biharsharif	Bihar
95	Bareilly	Uttar Pradesh
96	Itanagar	Arunachal Pradesh
97	Moradabad	Uttar Pradesh
98	Saharanpur	Uttar Pradesh
99	Kavaratti	Lakshadweep

Appendix D – Ethics Form

BOND UNIVERSITY

HUMAN RESEARCH
ETHICS COMMITTEE
Bond University
Gold Coast Queensland 4229
Australia

Phone: +61 7 5595 4194
(from overseas)

Email: ethics@bond.edu.au

ABN 88 010 694 121
CRICOS Provider Code 00017B

28 November 2017

Bhishna Bajracharya
Faculty of Society and Design
Bond University

Dear Bhishna

Application ID:	**16044**
Project Title:	**One Hundred Smart Cities: Developing an Urban Design Framework for Smart Cities in India**
Researchers:	**Bhishna Bajracharya, Kayal Chandrasekar, Daniel O'Hare**

I am pleased to confirm that your project was reviewed by Bond University Human Research Ethics Committee and you have been granted approval to proceed.

The Committee requires, as a condition of approval, that all investigations be carried out in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research* (2007). Approval is subject to conduct of the research in accordance with the requirements set out in the National Statement.

Approval is given subject to the protocol of the study being undertaken as described in your application, and approved amendments. As you may be aware the Ethics Committee is required to annually report on the progress of research it has approved. We would greatly appreciate if you could respond promptly and fully to the request for information on this project which will be distributed in March/April each year.

Under the terms of the National statement BUHREC has a role to monitor approved research projects and if necessary may withdraw approval. Conduct of unapproved research or deviation from the approved protocol may constitute academic misconduct and will be investigated in accordance with Part B of the *Australian Code for the Responsible Conduct of Research* (2007). Please refer to the Research Ethics website for more detail on Research Integrity and Bond University processes for dealing with instances of research misconduct.

You are reminded that the Principal Investigator must immediately report anything that might warrant review of ethical approval of the project. Should you have any queries or experience any problems, please contact us promptly.

We wish you well with your research project.

Yours sincerely

Dr Mark Bahr
Chair Bond University Human Research Ethics Committee

bond.edu.au

INAppendix E - Research Explanatory Statement

05 October 2017

Ethics Reference No: 0000016044

My name is Kayalvizhi Sundarraj Chandrasekar and I am currently completing a Doctor of Philosophy degree at Bond University, Australia under the supervision of Dr.Bhishna Bajracharya, Associate Professor in the Faculty of Society and Design.

I am conducting a research investigation into the relevance of urban design in smart cities in India. I am specifically interested in evolving an urban design framework that would serve as a for guideline improving urban design quality of cities, using appropriate technology to facilitate this process.

As part of this study, I will invite you to participate in a face to face semi-structured interview that should take approximately 60 minutes and can be done at your convenience.

Participation in this study is completely voluntary and you may withdraw at any time without risking any negative consequences. If you choose to withdraw your participation in this study, the information you have provided will be immediately destroyed. Participants' identity will be treated as confidential and the anonymity of the participant will be assured.

Data collected during the interview will be retained by the researcher indefinitely as the data collected will be potentially of high academic value to the discipline. Data will also be stored in a secured location at Bond University for a period of 5 years after publication of the thesis and then disposed after this period, in accordance with the guidelines set out by the Bond University Human Research Ethics Committee.

It is anticipated that the data collected during this study will assist me in understanding how the urban design and planning component of the smart cities mission in Indian cities. Your participation in this study will enhance work towards understanding smart cities transformation in cities in global south.

If you experience distress from participation in this research, please contact AASRA at +912227546669 .

Should you have any complaints concerning the manner in which this research is being conducted please make contact with –

Bond University Human Research Ethics Committee,
Bond University Office of Research Services.
Bond University, Gold Coast, 4229, Australia
Tel: +61 7 5595 4194 Fax: +61 7 5595 1120 email: ethics@bond.edu.au

We thank you for taking time to assist us with this research.

Yours sincerely,

S.C.Kayalvizhi

Kayalvizhi Sundarraj Chandrasekar

PhD Student

Appendix F- Participant Consent Form

Faculty of Society and Design

Research Project	**: One Hundred Smart Cities- Developing an Urban Design Framework for Smart Cities in India**
Name of the Researcher	**: Kayalvizhi Sundarraj Chandrasekar**
Principal Supervisor	**: Dr.Bhishna Bajracharya**
Project Ethics Application No	**: 0000016044**

I agree to take part in the above Bond University research project. I have read the Explanatory Statement and I am willing to:

- be interviewed by the researcher
- allow the interview to be videotaped/audiotaped

I also understand that my participation is voluntary; that I can choose not to participate in part or all the project, and that I can withdraw freely at any stage of without penalty. I wish to **a) remain anonymous or b) consent to be identified** during the recording of the interview (please strike out a or b whichever is irrelevant).

I understand that the non-identifiable data collected from my participation may contribute towards publications on the research subject, and I consent for it to be used in that manner. I understand that the data collected will be retained by the researcher indefinitely.

Name of Participant: ....

Signature of Participant: ....

Date: ....

Appendix G – List of key respondents

S.No.	Key- informant	Organisation
1	Dean (Architect and Urban Planner)	MEASI Academy of Architecture, Chennai
2	Design Chair (Architect)	MEASI Academy of Architecture, Chennai
3	Chief Planner -Master Plan Division	Chennai Metropolitan Development Authority
4	Architect and Urban Designer	Urban Design Collective, Chennai
5	Architect and Urban Designer	Chennai
6	CEO	Chennai Smart Cities Limited
7	Visiting Professor of Urban Planning and Former Deputy Director of the Department of Town and Country Planning	Anna University, Chennai
8	National Director, Head of Operations- Strategic Consulting	Jones Lang Lasalle, Chennai
9	Assistant Professor-Urban Planning and Environmental Engineering	Tamilnadu Institute of Urban Studies, Coimbatore
10	Official	Coimbatore Smart Cities Limited
11	Architect and Urban Designer	Coimbatore
12	Environmental Activist	Siruthuli, Coimbatore
13	Secretary	Coimbatore Resident Awareness Association
14	President	Indian Green Building Council -Coimbatore Chapter and CREDAI
15	Deputy Town Planner	Town and Country Planning Department, Coimbatore
16	Practising Architect and Academic	Harvard University

Appendix H – Key informant interview questions

1. What is your view on the smart cities mission of India?
2. What will be the impact of the smart city proposal on Chennai/Coimbatore's urban space?
3. Does the area-based smart cities proposal effectively address all issues in that specific urban space/locality?
4. What, according to you, are the challenges that could hamper the progress or implementation of the projects, in your opinion?
5. Do you believe the proposals within the area-based development will improve the quality of urban spaces in the city?
6. Which technologies indicated in the proposal do you consider will improve the quality of the urban space – e.g., the command control centre, smart transit system, smart lighting etc.
7. Is there enough participation or interaction between various government departments/planning authorities/ private consultants for these projects?
8. Do you think the intent of the proposals and their implementation plans along with associated costs communicated effectively to the broader community?
9. Is there any urban design feature/smart technology that you would like to be implemented in the area-based proposal based on examples in another Indian city or abroad?
10. Given that the area-based proposal is considered as a pilot project or testbed, is there a vision for long term city-wide smart cities implementation?
11. Other comments