Smart City and Related Implementation Challenges
Case Study: Kakinada and Kanpur

Khushboo Gupta

A dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Planning, Governance, and Globalization

Ralph P. Hall, Chair
Wenwen Zhang
Shalini Misra
Thomas W. Sanchez
Adam Eckerd

December 20, 2019
Blacksburg, Virginia

Keywords: Smart Cities, Smart Cities Mission, Smart City Risks, Revealed Causal Mapping, Risk co-occurrences, Smart City Enablers, Smart City Components and Smart City Goals

SMART CITY AND RELATED IMPLEMENTATION CHALLENGES
Case Study: Kakinada and Kanpur

Khushboo Gupta

ACADEMIC BSTRACT

With advancement in information and communication technologies (ICT), Smart Cities are becoming a popular urban development strategy amongst policy makers and city managers to respond to various threats posed by rapid urbanization such as environmental degradation and increasing inequality (Hartemink, 2016). Therefore, globally, regions ranging from small towns to mega cities are proposing and investing in smart city (SC) initiatives. Unfortunately, the prolific use of this term by city managers and technology vendors is clouding the view on what it really takes to become a SC (Van den Bergh & Viaene, 2015). Consequently, cities are experiencing multiple implementation risks when trying to turn a smart city ambition into reality. These implementation risks reflect the gaps or missing pieces in the current organizational structure and policies designed for implementing SC projects at the city level. They can be understood better if the process of SC transformation is explored using diverse cases of cities undergoing such a transformation. However, the current studies on SC initiatives at the local, regional, national, and international level have focused on: 1) strengthening the SC concept rather than understanding the practical implementation of the concept – i.e., discussing SC characteristics and outcomes rather than focusing on the challenges faced in implementing SC projects; 2) cases that have already been developed as a SC or are soon to become a SC, leaving out the opportunity to study cities undergoing SC transformation and the identification of implementation risks; and 3) cases from more advanced economies. Taken together, these observations reveal the need for research that focuses on SC initiatives in a developing nation context. More specifically, there is a need for

researchers, city managers, and policy makers in these regions to focus on the process of SC transformation to identify implementation risks early on in the process. Understanding these risks may help the development of better risk mitigation strategies and result in more successful SC projects. This research explores SC implementation risks in two cities currently undergoing a SC transformation in India – Kakinada and Kanpur. While examining the risks landscape in these two cities, the research also explores what city officials are focused on when implementing SC projects.

This research finds that: 1) implementation risks such as Institutional, Resource and Partnership, and Social are crucial for implementing SC projects; 2) in the cities of Kakinada and Kanpur, Institutional risks that relate to gaps and deficiencies in local urban governance such as overlapping functions of multiple local urban development agencies, have causal linkages with other risks such as Resource and Partnership risks and Financial risks, which further delay project implementation; and 3) city officials and industry professionals implementing SC projects in Kakinada and Kanpur have a slightly different perspective on smartness, however both the groups focus on *External* smartness of the city – i.e., projects related to physical infrastructure such as mobility and sanitation – rather than *Internal* smartness of the city – i.e., strengthening local urban governance, increasing citizen engagement, etc. Overall, this research proposes that there is a need to frame the concept of a SC around both *Internal* and *External Smartness* of the city.

This research will be of special interest to: 1) cities (in both developed and developing nations) currently implementing SC projects by providing a framework to systematically examine the risk landscape for successful project implementation; and 2)

communities/institutions (especially in developing nations) proposing SC initiatives by helping them focus on components, goals, and enablers of a SC.

SMART CITY AND RELATED IMPLEMENTATION CHALLENGES
Case Study: Kakinada and Kanpur

Khushboo Gupta

GENERAL AUDIENCE ABSTRACT

The concept of a Smart City (SC) revolves around "using Information and Communication Technologies (ICT) to increase workability, liveability, and sustainability" of a city (Smart Cities Council, 2014). SCs are becoming a popular urban development strategy amongst policymakers and city managers to respond to various threats posed by rapid urbanization such as environmental degradation and increasing inequality (Hartemink, 2016). Unfortunately, city managers see SCs as a readymade solution to urban challenges. As a consequence, cities are experiencing multiple implementation risks when trying to turn a smart city ambition into reality. These implementation risks reflect the gaps or missing pieces in the current organizational structure and policies designed for implementing SC projects at the city level. They can be understood better if the process of SC transformation is explored. However, the current studies on SC initiatives at the local, regional, national, and international level have focused on: 1) strengthening the SC concept rather than understanding the practical implementation of the concept; 2) cases that have already been developed as a SC or are soon to become a SC, leaving out the opportunity to study cities undergoing SC transformation and the identification of implementation risks; and 3) cases from more advanced economies. Taken together, these observations reveal the need for research that focuses on SC initiatives in a developing nation context. More specifically, there is a need for researchers, city managers, and policymakers in these regions to focus on the process of SC transformation to identify implementation risks early in the project development process. Understanding these risks may help the development of better risk

mitigation strategies and result in more successful SC projects. This research explores SC implementation risks in two cities currently undergoing a SC transformation in India – Kakinada and Kanpur.

This research finds that: 1) implementation risks such as Institutional, Resource and Partnership, and Social are crucial for implementing SC projects; 2) in the cities of Kakinada and Kanpur, Institutional risks that relate to gaps and deficiencies in local urban governance such as overlapping functions of multiple local urban development agencies, have causal linkages with other risks such as Resource and Partnership risks and Financial risks, which further delay project implementation; and 3) city officials and industry professionals implementing SC projects in Kakinada and Kanpur have a slightly different perspective on smartness, however both the groups focus on the External smartness of the city – i.e., projects related to physical infrastructure such as mobility and sanitation – rather than the Internal smartness of the city – i.e., strengthening local urban governance, increasing citizen engagement, etc.

DEDICATION

I dedicate this Dissertation to my family who has been a true motivation and driving force for all my achievements and actions. I would like to especially mention some people who have made this journey possible. My parents who empowered me to dream big and achieve them. And all my achievements so far are dedicated to their hard work. My best friend and now my husband, Keshav who has always been supportive and encouraging of my personal and professional pursuits and kept my spirits up even during the low periods of this journey. My wonderful sister, Ayushi who has been my go to person throughout this PhD journey. She has always lent her ears to all my rants and has made me see the positive.

ACKNOWLEDGEMENT

I would like to thank my committee members for their valuable time and guidance provided over the last four and half years. I would like to especially thank Dr. Ralph P. Hall for always encouraging me and guiding me through the doctoral program as my committee chair and mentor, as well as an invaluable advisor on administrative and teaching matters. Dr. Hall has also provided useful advice related not only to my dissertation research but also on how to become an overall better scholar in the broader professional community. I would like to express my appreciation to Dr. Wenwen Zhang, Dr. Shalini Misra, Prof. Thomas W. Sanchez, and Dr. Adam Eckerd for all their valuable advice and support granted over the years. I would also like to acknowledge all UAP faculty and staff who welcomed me to the department, as well as equipped me with their experiences and insights to better prepare me for the academic life. I would like to thank my advisors at the Indian Institute of Technology Kanpur, Prof. Sudhir Misra, Prof. Onkar Dikshit, and Prof. Bharat Lohani who introduced me to research. I am grateful to the Obama-Singh Knowledge Initiative which introduced me to the faculty of VT SPIA, especially my doctoral advisor, Dr. Hall. In addition, special thanks to the Dean, CAUS for providing me funding support to travel to India and conduct my research.

I would like to thank Dr. Provo for providing me the opportunity to work as a graduate assistant at the Office of Economic Development and exposing me to interesting and diverse projects related to local development to international development. I met with a lot of people at OED who taught me different skills and I will always try to apply them in my journey ahead.

Thanks to Krystal and Leigh for keeping me on track with completing paperwork and administrative tasks ensuring a seamless voyage through the doctoral program. I would also like to appreciate my in-laws for their encouragement and support in this journey. I also

greatly appreciate all the kind words of encouragement and support from my fellow doctoral students, Neda, Huyen, Hye-Jeong, Raj, Qiong, Marc, Trevor, Sarah, and Omchand. I would also like to acknowledge my roommates and friends, Nistha, Esha, Balu, Aishwarya, Komal, Khem, and Shubhankar for their love and support in this journey.

Lastly, I would like to acknowledge all my interviewees who have participated in my research study and anonymous reviewers who have provided their much-appreciated feedback on my various papers.

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

Information and Communication Technologies	ICT
Smart City	SC
Smart City Mission	SCM
Ministry of Urban Development	MoUD
Urban Local Bodies	ULB
Integrated Development of Small and Medium Towns	IDSMT
Jawaharlal Nehru National Urban Renewal Mission	JNNURM
Government of India	GoI
Ministry of Housing and Urban Affairs	MoHUA
Area-based development	ABD
Pan-city development	PAN
Smart City Proposal	SCP
Special Purpose Vehicle	SPV
Union Territory	UT
Chief Executive Officer	CEO
Public-Private Partnership	PPP
Topic model	TM
Latent Dirichlet Allocation	LDA
Non-negative matrix factorization	NMF
Keyword Co-occurrence Network	KCN
Land Acquisition, Rehabilitation, and Resettlement	LARR
Command and Control Centre	CCC
Intelligent Traffic Management System	ITMS

Chapter 1: INTRODUCTION

1.1. Overview

Smart Cities (SCs) are becoming a popular urban development strategy amongst city leaders to better manage rapid urbanization challenges such as environmental degradation and increasing inequality (Hartemink, 2016). Therefore, globally, cities are investing intensively in SC development which calls for attention on successful implementation of these SC activities. Further, this necessitates the identification and exploration of risks that may hamper project implementation. Current SC scholarship focuses on developing frameworks/metrics that identify SC components and develop SC rankings, rather than addressing why SC projects are successful in one place and not in another. In other words, current SC scholarship lacks an understanding of the risk landscape in SC project implementation. There are some studies that identify these risks/challenges/barriers in a broad way, but are mostly limited to SC cases from developed nations (Monzon, 2015; Ojo, Curry, & Janowski, 2014). Moreover, most studies on SC challenges do not provide a systematic mechanism to analyze them (Angelidou, 2015). Unless SC risks are analyzed comprehensively, the planned mitigation measures are not likely to be effective in responding to these SC risks. The research focuses on filling this knowledge gap by identifying risks associated with SC implementation in the Indian context.

While exploring SC literature, it was found that most scholars either support SC development and/or criticize it. However, there is a lack of research that discusses the process of SC transition. Previous studies on smart cities have defined and built the SC concept from experiences in early SC development in more advanced economies of the European Union, the United Kingdom, the United States, and in some parts of Asia. Moreover, most SC studies relied on the technological aspect of SCs, meaning the application of new technologies in

planning smart transport or in improving environmental conditions (Benner, 2003; A. S. Caragliu, 2011). Some researchers also focus on policy frameworks or smart governance in the context of a SC (Shapiro, 2008; Torres, Pina, & Acerete, 2005; Yovanof & Hazapis, 2009). However, very few studies have considered a city's development level, political stability, technology penetration, social demographics, and its economy in their analysis (Kitchin, 2015; Shelton, Zook, & Wiig, 2015). A city's context is important since it may explain why a particular technology or policy framework worked in one location and not in another (Kitchin, 2015). Moreover, the local conditions also put forth several risks in successfully implementing these SC initiatives. Therefore, it is important to study the SC transition process to highlight goals, components, and enablers of SC development, which can provide insight into better and more effective management of SC risks that are identified.

This research views a smart city not in terms of how 'smart' it is, but in terms of its efforts to become smart. It therefore understands and uses the concept of Smart Cities as "A city investing in people, processes, and/or technology to upgrade existing urban services for improving the quality of life of the citizens." Further, this study explores how smart cities are being understood in a developing nation context using the case of India's Smart Cities Mission (SCM). SCM is a national urban mission launched in 2015 by the Government of India (GoI) in response to the challenges presented by rapid urbanization (Ministry of Urban Development, 2015).

Most urban missions/strategies introduced by local, state, or federal governments in any country are a response to the challenges caused by rapid urbanization. This chapter briefly describes the history of urbanization in developed and developing nations, followed by providing an overview of previous urban missions implemented by the Government of India.

Next, the chapter discusses the background of the Indian SCM and its implementation plan. The chapter then describes previous SC studies, highlighting major research gaps, and finally concludes with a discussion of the three-paper structure of the dissertation.

1.2. Urbanization in Developed and Developing nations

Urban areas have played an increasing role in absorbing large shares of the world's population in developing and developed countries (Renaud, 1987). However, the pace and scale of urbanization have varied in both contexts. According to Renaud (1987) in most western countries, urbanization took many decades and occurred relatively slowly in comparison to the pace of urban transformation that occurred (and is occurring) in developing nations. For instance, India has witnessed a slow but steady urbanization growth from 18% in 1960 to 31% in 2010 (Chauvin, Glaeser, Ma, & Tobio, 2017) . In 2010, the country had 373 million urbanites living in cities with more than 100 thousand people (Chauvin et al., 2017). While India's urbanization rate has been slower than that of some developing nations such as Brazil and China, the scale of urbanization in India has been large.

The pace of urbanization and the influence of industrial revolutions have shaped urban policies in both developing and developed nations. Until the 1960s, advanced and developing countries alike were seen as moving along an urbanization curve, with the advanced countries preceding developing countries (Renaud, 1987). In the 1970s, two major structural changes became apparent in developed countries, and their impact on urban policies became pronounced. These structural changes included the urbanization of national populations and beginning of the third industrial revolution (which was based on new energy systems, electronics, information industries, bioengineering, and services). Post 1970s, the urban policy issues were not only framed in response to their spatial and economic environment but

were influenced by the dominant role of multi-locational and multi-functional corporations (Renaud, 1987). Confronted with urban growth, advanced countries developed policies incrementally and responded to problems as they emerged. In contrast, the rapidly shifting patterns of population distribution and economic activity in most developing countries created inequalities in economic growth rates, industrial structure, employment conditions, household incomes, wages, and level of services. These consequences of rapid urbanization prompted policymakers to experiment with spatial programs in their national economic policy schemes that focused on urban policies to better manage rapid urbanization in cities. These urban policies were formulated and tried in the same incremental way that were characteristic of advanced countries during their decades of rapid urbanization, but were unstructured. Moreover, most urbanization policy in developing countries were (and are) based on assumptions rather than on established findings.

1.3. Urban Missions in India

Developing nations such as India witnessing rapid urbanization are also facing higher population growth with lower income levels, and have limited opportunities to relieve domestic population through migration. With over-concentration of population, rapid urbanization has led to serious urban issues failing to keep pace with infrastructure development and service delivery (An, 2015). Consequently, resulting into more slums and widespread “urbanization of poverty” exerting significant pressure on the environment (Ness, 2007). Additionally, increasing land constraints are on the rise. In the past, several policies and national level strategies have been implemented to respond to the increasing levels of urbanization.

India's three layered governance structure is comprised of the Central Government (Ministry of Housing and Urban Affairs) which is the apex institution, State Government (consisting of core departments related to Municipal supervision, Town planning, and Urban Development), and Local Government (Urban Local Bodies (ULB) such as Development Authorities, Municipal Corporations, Municipalities, and Nagar Panchayats). The Indian Constitution puts the mandate of 'urban development' in the hands of the State. However, only a few State governments have been able to take sufficient steps towards the development of their cities. Further, due to varying economic, technological, or political conditions, many States fail to manage their jurisdictions effectively, much less aim for pushing them towards achieving global standards (Aijaz & Hoelscher, 2015). Previous reports have indicated that ineffective governance of cities is closely related to the lack of capacity of ULBs (Aijaz & Hoelscher, 2015). ULBs have a 300-year history (Vaidya, 2009), and are the key service providers to citizens. ULBs are responsible for delivering services, maintaining the city's basic infrastructure and for mobilizing local resources (e.g., through user charges and land taxes). Yet are considered weak, impairing urban infrastructure development in India (Aijaz & Hoelscher, 2015; Meloche & Vaillancourt, 2015). It is because, in reality, "local government bodies do not have adequate funds, capacity, or power to provide these services" (Ahluwalia, 2017). Previously, the GoI attempted to decentralize urban governance by enacting the 74th constitutional amendment in 1992 by vesting ULBs with status and powers (Vidyarthi, 2004). However, the actual implementation varied greatly from state to state. These deficits are why the central government has on various occasions stepped up to guide city development.

The Government of India has launched several schemes in response to challenges facing towns and cities such as Environmental Improvement of Urban Slums, Integrated Urban Development Programme and Integrated Development of Small and Medium Towns

(IDSMT). IDSMT was introduced in 1979 with the focus to “improve the economic and physical infrastructure of urban settlements with populations of up to 500,000, so that these would be in a position to generate economic growth and control the problem of migration to larger cities” (Gauba, 2017). In this regard, the Planning Commission of India noted that 1,854 towns were covered, but their performance was not satisfactory due to a lack of implementation capacities, non-availability of matching State funding, and non-availability of unencumbered land for the projects (Gauba, 2017). In 1993, the Mega City Scheme was introduced in five cities. Under this initiative, the focus was on infrastructure development, and a wide range of projects were approved and implemented (Gauba, 2017). The two schemes continued until 2005, but progress was severely hampered due to various reasons including insufficient funds (Ahluwalia, 2017; Aijaz & Hoelscher, 2015). A year later, a comprehensive scheme, the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), was launched in December 2005. Under this scheme, 65 cities were selected for infrastructure development and improved service delivery. Budgetary outlays were substantially increased, service-levels benchmarks, and indicators were adopted, and a range of state and local level reforms were introduced to improve the quality of governance. Some policy experts argued that JNNURM failed to achieve significant renewal because of implementation barriers that included the lack of participation of communities/stakeholders in the planning process, the lack of political support for housing and slum development projects, and the lack of capacity and expertise among local officials (An, 2015).

1.4. Approaching Smart City Concept for Comprehensive Urban Development

Based on experiences from previous missions, policy makers realized the need to shift the way urban infrastructure is planned, designed, and managed in India. In particular, the need to tackle rapid urbanization more holistically, meaning that urban infrastructure needs to be

provided in an efficient, effective, and innovative way. In this regard, the Government of India (GoI) launched Smart Cities Mission in 2015.

1.5. Smart Cities Mission

The Smart Cities Mission (SCM) is a national initiative launched by the Ministry of Urban Development (MoUD) (which is now known as the Ministry of Housing and Urban Affairs) aiming to develop 100 smart cities (shown in Figure 1) (Ministry of Urban Development, 2015). It is a program to promote urban development in India through the application of smart solutions (Ministry of Urban Development, 2015).

1.5.1. Mission Objective

'Smartness' is generally associated with technology and other ICT based solutions, but in the context of India the term 'smartness' focuses on establishing more efficient core (basic) infrastructure related to water and waste management, power generation, sanitation, and transportation. The Ministry of Housing and Urban Affairs in India describes the smart city concept as, **"building cities that provide core infrastructure and give a decent quality of life to its citizens"** (Ministry of Urban Development, 2015). It further promotes the development of cities with **"a clean and sustainable environment"**, using **"smart"** solutions (Ministry of Urban Development, 2015). The mission is focused on building inclusive cities that enhances standard of living for citizens and provides employment opportunities to them. Previously, the mission had a five-year mandate which has been extended to next five years. Under SCM, the Central Government and the State Governments have committed to provide an equal contribution to the selected cities (Ministry of Urban Development, 2015). As of March, 2018, the ministry has released INR 10,459.2 Crores (i.e. 1.48 billion USD) to State/Union Territories for SC development (Ministry of Housing and

Urban Affairs, 2018). SCM is seen as a bold initiative that marks a clear shift away from "business as usual" in India's urban development. The goal of SCM is to promote economic growth and improve quality of life by enabling two types of local development: (a) Area-based (small-scale) development (ABD) projects and (b) Pan-city (large-scale) development (PAN) projects. ABD projects will either transform existing areas, including slums, by retrofitting and redevelopment to enhance current living conditions or carrying out green-field projects that will develop new areas in the city to accommodate the expanding urban population. PAN projects envisage the application of selected smart solutions to existing city-wide infrastructure (Ministry of Urban Development, 2015).

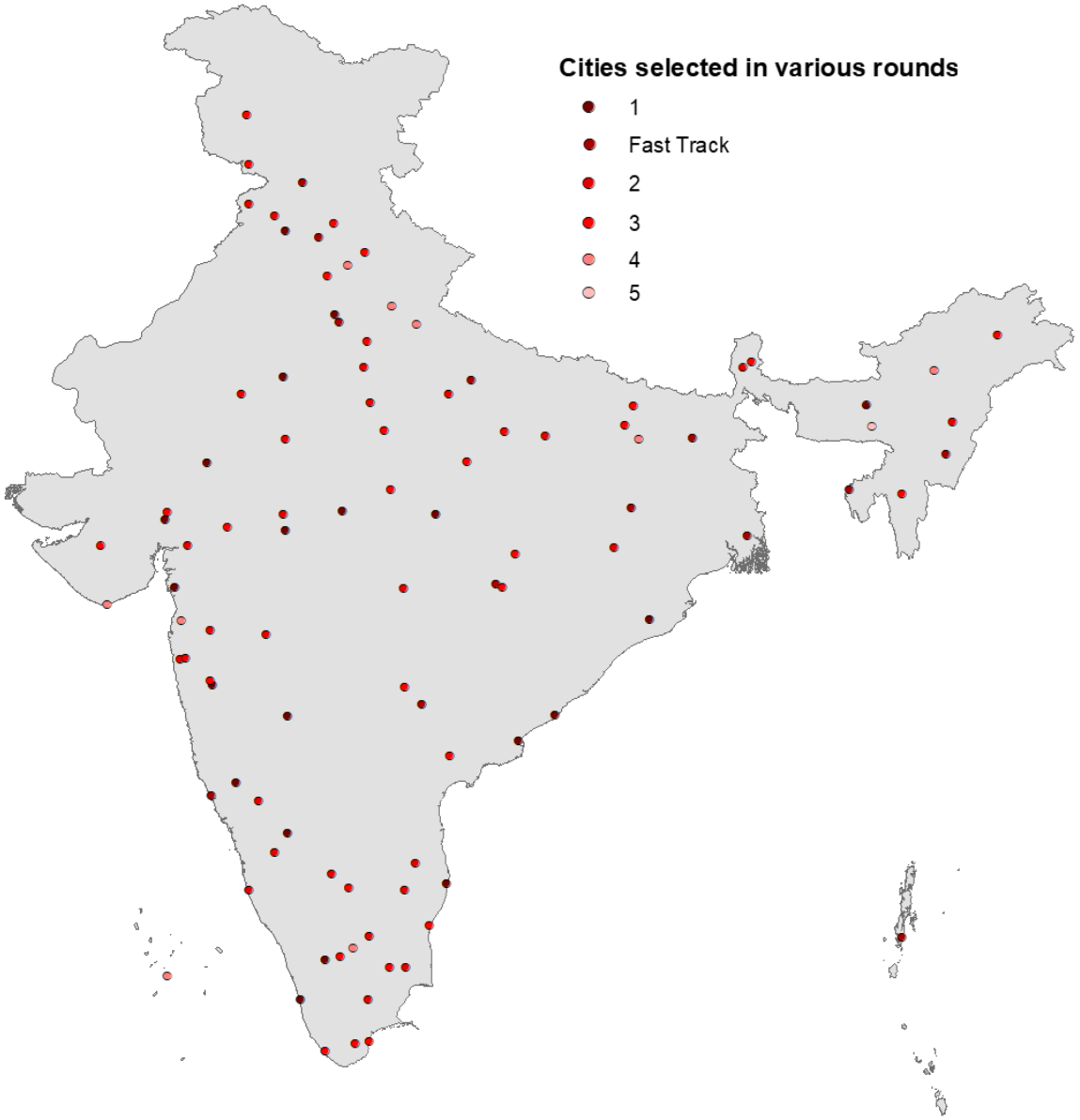


Figure 1: Geographical location of 100 smart cities in various rounds in India (Ministry of Housing and Urban Affairs, 2019).

1.5.2. Overall Mission Plan and Status

The SCM has been designed as a competitive process (shown in Figure 2), first, the States shortlisted the cities to be participating in the SCM and the names were made public in

August 2015. The shortlisting was made based on standardized criteria, such as the cities' records of completing a number of already defined urban development goals (Ministry of Urban Development, 2015). Second, a total of 98 cities were chosen and each state was guaranteed at least one city in the competition. Each city developed a Smart City Proposal (SCP), which was assessed by the MoHUA. A SCP is roughly, a 90-100 page-long document excluding annexures, and included city's self-assessment, their vision of smartness, strategy to implement the mission, citizen engagement process, funding scheme, etc. Third, based on the assessment of SCPs, 20 cities were selected in the Round 1. Those not chosen for funding in Round 1 were returned and asked to adapt or adjust their SCP for the second round. The 20 cities selected in the first round did not cover all States/Union Territories (UTs). Therefore, the MoUD provided a second chance to the remaining states/UTs through a special 'fast track' round, to submit their upgraded proposals before the second round.

The mission guidelines on the SCM website mentions that "SCPs were assessed through evaluation metrics based on the vision, goal, strategy, and scope for improvements with regards to the city" (Ministry of Urban Development, 2015). The assessment of SCPs also evaluated the citizen engagement strategy developed by the cities. These strategies included the types of individuals, groups, and communities targeted, the engagement methods used, the design of feedback loops, and processes for integrating citizen ideas in planning of smart cities. ABD and PAN projects were assessed with regards to conceptualizing 'smartness' by the cities, impact of becoming smart, detailed implementation framework, and cost effectiveness of the initiated projects.

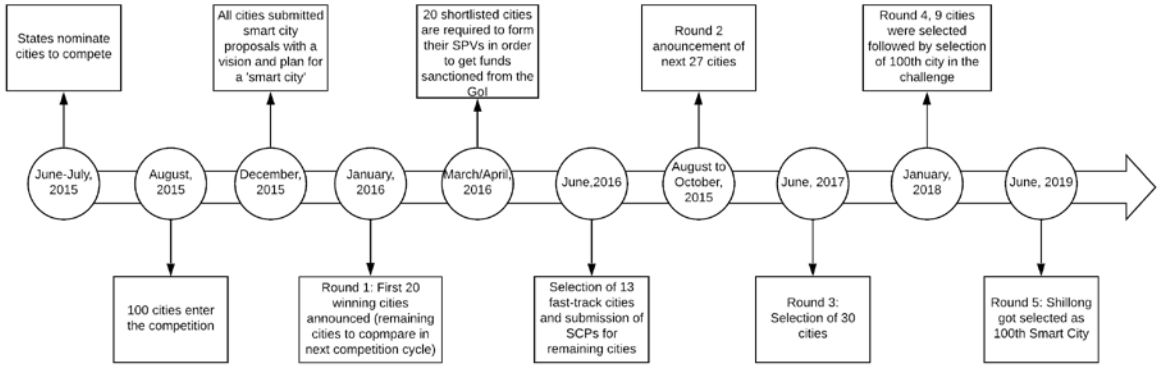


Figure 2: SCM's timeline and update (data used from the SCM's website (Ministry of Urban Development, 2015)).

1.5.3. Smart City Implementation

The monitoring of the entire SCM program is conducted on a three-tiered governance structure headed by an Apex committee that includes various national, state-led, and city-level committees (as shown in Figure 3). The mission implementation at the city level is done by a Special Purpose Vehicle (SPV). The SPV plans, releases funds, implements, manages, and evaluates the SC projects. It is led by a full time Chief Executive Officer (CEO) and has nominees from the Central Government, State Government, and a ULB on its Board (Ministry of Urban Development, 2015). The SC projects are executed through joint ventures, subsidiaries, public-private partnership (PPP), etc. Moreover, the cities have employed a convergence mechanism for generating funding for the SC project. These convergence schemes let the cities obtain funds from other active missions, including the Digital India, Housing for All, National Heritage Skill Development, and Swachh Bharat Missions. This study focuses on SC implementation at city level and therefore examines the city-level entity managing and implementing SC projects, called the Special Purpose Vehicle.

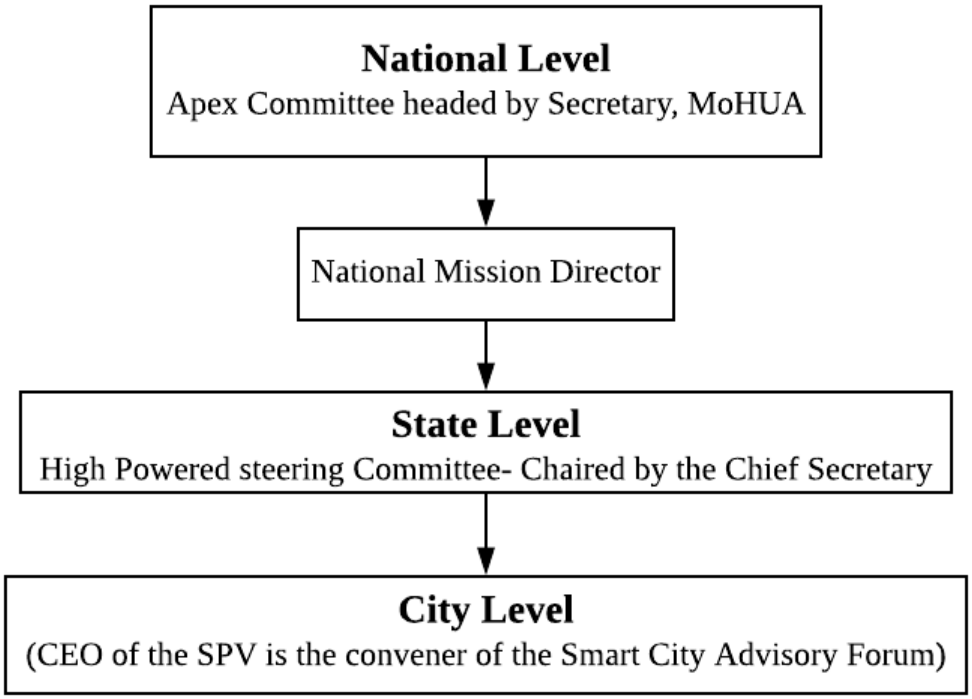


Figure 3: Governance structure of Smart Cities Mission (Ministry of Urban Development, 2015).

1.6. Organization of Dissertation

This dissertation is divided into three papers described in Chapters 2, 3, and 4 (Figure 4).

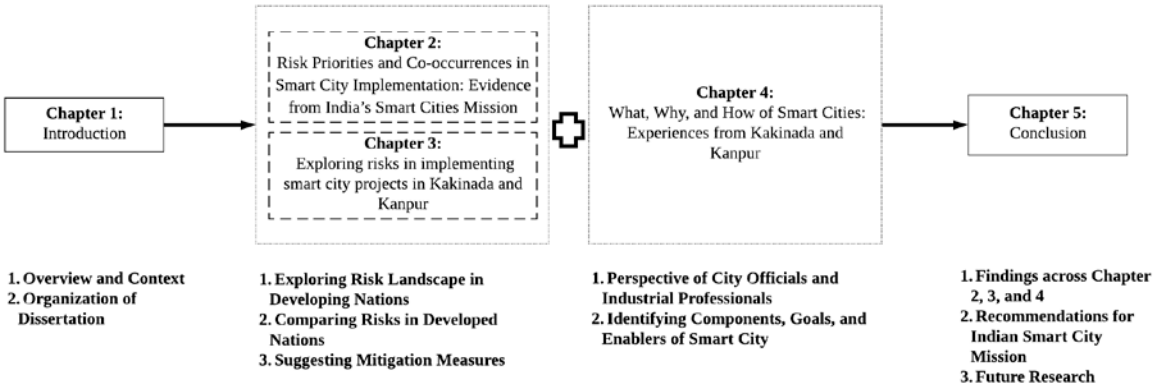


Figure 4: Organization of Dissertation.

Papers 1 and 2 focus on exploring SC implementation risks associated with projects funded by the Indian SCM. The papers study a broad range of risks and highlight the significance of Institutional risks, Resource Management and Partnership risks, Scheduling and Execution

risks, and Social risks as critical to project implementation. Further, these papers highlight the presence of causal linkages between these risks in the cities of Kakinada and Kanpur. These risks and their causal linkages indicate lack of internal smartness of the city which in turn corresponds to the various mission policies/guidelines at the national level. The term 'Internal Smartness' can be described as attributes such as collaboration, citizen participation, and integration of urban services that are not physical but are equally important for a city to become smart. While studying risks, the SC transformation processes in the cities of Kakinada and Kanpur were also explored. These explorations further emphasize that the city officials are presently focusing on a city's 'External Smartness', which relates to the projects and their physical outputs such as improved mobility, cleaner environment, and upgraded urban services.

The three papers in the form of Chapter 2, 3, and 4 provides sufficient knowledge to develop two constructs, 'Internal Smartness' and 'External Smartness', which need further validation through future research. These constructs are discussed in more detail in the concluding section. In addition, the concluding chapter provides recommendations for reducing risks associated with SC projects the cities of Kakinada and Kanpur.

This chapter began with a brief introduction to urbanization in developed and developing nations and discusses how urbanization trends shape their urban missions/strategies. The chapter then described the previous urban missions in India, including the SCM that is the focus of this research.

Chapter 2 entitled "**Risk Priorities and Co-occurrences in Smart City Implementation: Evidence from India's Smart Cities Mission**" presents SC risks in implementing projects under the SCM in the selected Indian cities by examining the risk tables mentioned in the

SCPs for 33 proposed smart cities. This research seeks to answer the following three research questions:

1. **What are the various risks associated with SC project implementation in developing countries?**
2. **How do risk priorities vary for ABD and PAN projects? and**
3. **What are the possible co-occurrences of the various identified risks?**

The study findings discuss how risks vary with the scale of projects. In addition, the research also identifies risks co-occurrences indicating risk linkages. Lastly, the study compares SC risks found in the Indian context with existing SCs in developed nations and suggests mitigation measures. While this study identified risk linkages, it did not identify the causal relationships between the risk categories.

Chapter 3 entitled "**Exploring risks in implementing smart city projects in Kakinada and Kanpur**" studies the risk co-occurrences identified in Chapter 2 by examining the risk landscape in implementing smart city projects in two proposed Indian cities, Kakinada and Kanpur. This study focuses on two research questions:

1. **What is the risk landscape in the cities of Kakinada and Kanpur?**
2. **How can we validate the risk co-occurrences found in the previous chapter?**

The chapter draws from interviews with 20 professionals who were closely associated with implementing smart city projects. Further, this study models the risk interrelationship using causal mapping techniques. The focus on the two cities provided a better sense of the challenges experienced when trying to implement the SCM. However, these challenges have raised questions about the enablers of SC projects.

Chapter 4 entitled "**What, Why, and How of Smart Cities: Experiences from Kakinada and Kanpur**" explores the SC transformation of Kakinada and Kanpur. This case study aims

to explore how ‘smartness’ is understood in these cities and examines the local conditions shaping SC objectives by studying the existing issues in the cities, the proposed projects, and the perception of 20 SC experts in relation to the following three questions:

1. **What do cities understand by ‘smartness’?**
2. **Why cities want to become smart? and**
3. **How will the cities become smart?**

The study raises some important questions that communities planning to implement similar initiatives should answer before implementing any project.

Chapter 5 concludes the dissertation, summarizes the findings of the three papers, provides recommendations to the SCM and other regions proposing similar initiatives, identifies the limitations of this study, and outlines future research.

Chapter 2: FRAMEWORK FOR RISK CLASSIFICATION AND ANALYSIS OF SMART CITY PROJECTS IMPLEMENTATION IN INDIA

Abstract

With an increasing number of smart cities initiatives in developed as well as developing nations, smart cities are seen as a catalyst for improving the quality of life for city residents. However, current understanding of the risks that may hamper successful implementation of smart city projects remains limited due to inadequate data, especially in developing nations. The recent Smart City Mission (SCM) launched in India provides a unique opportunity to examine the type of risks, their likelihood, and impacts on smart city project implementation by providing risk description data for Area-based (small-scale) projects (ABD) and Pan-city (large-scale) projects in the submitted smart city proposals. We used topic modeling (quantitative) and semantic analysis (qualitative) for risk classification, followed by risk likelihood-impact analysis for priority evaluation, and the keyword-co-occurrence network method for risk association analysis. The risk classification results identify eight risk categories for both the ABD and PAN projects which included a) Financial, b) Partnership and Resources, c) Social, d) Technology, e) Scheduling and Execution, f) Institutional, g) Environmental, and h) Political. Further, the likelihood-impact analysis shows that risks identified for ABD projects were distributed among low, medium, and high priority while risks for PAN projects were skewed towards high priority. This paper also highlights a strong association of institutional risk with financial, social, and partnership and resource risks for ABD projects, whereas there is a strong association of scheduling and execution risk with institutional, social, technological, and partnership and resource risks for PAN projects. The results of this study show that smart city projects across scales face different management

challenges in terms of risk priority as well as the association of risks. Therefore, the results indicate that different mitigation measures may need to be developed to manage small and large-scale projects.

Keywords: Smart Cities Mission, Risks, Likelihood-Impact, Risk co-occurrences

2.1. Introduction

The concept of a smart city (SC) has gained attention across the globe in the past decade. Communities are leveraging the power of Information and Communication Technologies (ICT) to enhance resource management and improve different aspects of cities such as ranging from health, safety, education, and transportation (Bakıcı, 2013). In the last two decades, several developing countries have invested intensively in technologies to develop smart cities (Joss, Cowley, & Tomozeiu, 2013). India's Smart Cities Mission (SCM) is a recent initiative launched by the Ministry of Urban Development (MoUD) to build 100 smart cities. SCM is the first significant step towards the comprehensive implementation of the SC concept in India and is described as "building cities that provide core infrastructure and give a decent quality of life to its citizens", and promoting development of cities with "a clean and sustainable environment" using "smart" solutions (Ministry of Urban Development, 2015). SCM initiated two types of local development: (a) Area-based (small-scale) development (ABD) projects that will either retrofit existing areas or carry out Green-field projects; and (b) Pan-city (large-scale) development (PAN) projects that envisage the application of selected smart solutions to existing city-wide infrastructure (Ministry of Urban Development, 2015). As of March, 2018, the ministry has released INR 10,459.2 Crores (i.e. 1.48 billion USD) to State/Union Territories for SC development (Ministry of Housing and Urban Affairs, 2018). Like India, several other developing countries have also provided a significant amount of financial support to launched SC initiatives. For instance, China invested around 15 billion USD in planning eco-cities (Joss & Molella, 2013), Rio de Janeiro invested 14 million USD in a Smarter Planet Initiative (Mora,

Deakin, & Reid, 2017), and South Korea introduced a national strategy in 2007 to develop ubiquitous cities (Kim, 2016).

Previously, SC initiatives used to be constrained in developing nations due to a lack of public and financial support for these investments (Yigitcanlar & Lee, 2014). In the past decade, this situation has changed with more resources being allocated to SC development. The success of emerging SC initiatives in developing countries depends heavily on the implementation of the smart projects. Existing studies suggest national SC missions are challenged by several implementation risks. For instance, some policy experts argue that Jawaharlal Nehru National Urban Renewal Mission (JNNURM) failed because of implementation barriers, such as the limited public engagement, insufficient local management capacity, and a lack of inter-department collaboration (An, 2015). Similar to JNNURM, the progress of project implementation under SCM has been very slow. The Ministry of Housing and Urban Affairs revealed that by February 2017 less than three percent of SC projects were completed and only 12 percent of central funds were released (Saldanha, 2018). Given these problems, understanding the landscape of risks in SC project implementation and how to prioritize risks according to the scale of projects is critical for successful SC projects implementation. However, most prior SC studies have focused on the characterization of a SC and success factors for SC project implementation in developed nations (Hamza, 2016). Thus, there is a limited understanding of SC risks in developing nations due to a lack of data and research.

The recent launch of SCM in India provides a unique opportunity to examine the risks associated with ABD and PAN projects implementation, along with their likelihood of occurrence and

impacts on project implementation. Through this research, we examined the risk landscape in implementing SC projects in a developing region by focusing on three research questions: (1) What are the various risks associated with SC project implementation in developing countries? (2) How do risk priorities vary for ABD and PAN projects? and (3) What are the possible co-occurrences of the various identified risks? The findings of this study may benefit city leaders, managers, and other SC implementers to pro-actively develop mitigation measures to enhance SC project management capacity in developing countries.

2.2. Smart City Development and Risk Management

2.2.1. Smart City Development and Barriers to Project Implementation

SC literature suggests that SC projects are different from conventional projects, have a wide-ranging scope, and are therefore more complex to implement. SC projects typically involve a mixture of construction, infrastructure implementation, and ICT integration, in addition to meaningful public involvement and available human resources with sufficient technological capability. Further, the implementation of SC projects may not seem to be as malleable as assumed in the SC policy documents due to the existing infrastructure of the cities and the difference in the ideologies of the actors implementing the projects (Shelton et al., 2015; Taylor Buck & While, 2017). For instance, Valdez, Cook, and Potter (2018) observed that outcomes from the SC projects in Milton Keynes, UK, deviated from the initial policy documents. To avoid such deviation and to successfully implement SC projects, there is a need to bridge the gap between SC roadmaps and project deployment. But first, it is important to explore risks in SC

development by focusing on the need for real-time city management by local authorities and other actors involved in SC implementation (Deakin, 2015; Wolfram, 2012).

Recent SC scholarship focuses on the study of SC initiatives implemented in developed countries from Europe and North America (Garau, 2014; Grimaldi & Fernandez, 2017; Maier, 2016; Mora, Deakin, & Reid, 2019), and Australia (Bulkeley, McGuirk, & Dowling, 2016). With the exception of Yigitcanlar and Lee (2014) who focused on SC initiatives in South Korea and Gaffney and Robertson (2018) who discuss SC initiatives in Brazil, only a few studies have examined SCs in a developing nation context. To date, several SC studies have briefly discussed the factors that are associated with successful project implementation. These factors include finance and human resources (Caprotti et al., 2017), technology (Harrison et al., 2010), policy and institutional reforms, local governance, and citizen participation (Chourabi et al., 2012). Some of the challenges with SC project implementation at the local level are also briefly addressed and include management and operations, politics, and coordination between local government agencies (Hartemink, 2016). Only a few studies discuss how these barriers/challenges impact SC project implementation. For instance, Joshi, Saxena, and Godbole (2016) discuss the factors that can result in successful projects in smart cities, emphasizing the relative importance of some factors such as technology over social and managerial (governance) factors. In contrast, the analysis of SC initiatives by Kogan and Lee (2014) explores the role of citizens and their engagement as the main factor in SC project success, with governance as a secondary factor. Similar findings were discussed by Martin, Evans, and Karvonen (2018) on empowering citizens to unlock more emancipatory and sustainable modes of smart urban

development. Another report on Creating Municipal Infrastructure by Kartman, Sandnes, and Smit (2011) describes a road-map to smart city development and recognizes the complexity of smart city systems that have data issues related with integration and convergence, and standardization and interoperability, along with differences in administrative maturity. In addition, they discuss financial challenges that relate to infrastructure and intelligent systems, and the business model delivery of smart services and finance innovation. Further, researchers such as Techatassanasoontorn and Suo (2010) identified a series of risks in municipal broadband projects in smart cities, including socio-political, financial, technological, partnership and stakeholder, and local-governance risks and discussed the relationship among these risks. Additionally, Lee, Yigitcanlar, Han, and Leem (2008) discuss barriers to implement SC projects in Korea and Japan such as high project cost, the long duration of projects, and considerable public educational and skill development requirements. However, the researchers also suggested that interested countries should learn through launching their own initiatives rather than observing and mimicking the projects already undertaken by others.

Given the above discussion, two major research gaps remain in the literature of SC project implementation: (1) the prior studies rely on case examples and, therefore, do not analyze barriers systematically (Angelidou, 2015) and (2) most studies focused on cases from developed countries, which fail to capture barriers typically found in developing countries, such as a lack of basic infrastructure, a scarcity of skilled labor, or poor rates of local technology adoption (Hamza, 2016). Thus, this study will address these research gaps by systematically reviewing

Indian SCM project implementation barriers using existing frameworks adopted in the project management literature.

2.2.2. Project Success and Risk Management

The risk management literature provides definition of the terms used in this study such as project success, risk, and its various sources. It further emphasizes the need for implementing risk management for any kind of project. Risk can be defined as "an uncertain event or set of circumstances that, should it occur, will have an effect on the achievement of the project's objectives" (Simon, 1997). Risk may come from multiple sources including political, societal, and technological risks, and if not managed properly they may lead to project delays, poor quality, and/or significant cost increases (Pheng, 2018). This complexity further indicates that success of any project mainly depends upon understanding the risks associated with the specific project and effective implementation of risk management systems (Walewski, Gibson, & Vines, 2002). Furthermore, the way risks are understood and described strongly influence the way the risks are analyzed which may result in serious implications for risk management (Aven, 2015). The risk management literature offers a structured way to understand risks and to respond to them. However, risk co-occurrences have not been discussed in length. Previous researchers have used risk management in various projects such as construction (Zou, Zhang, & Wang, 2007), infrastructural (Ibrahim, Price, & Dainty, 2006; Lam, 1999), and ICT-related projects (R. L. Kumar, 2002; Milis & Mercken, 2002) to successfully implement projects. These studies emphasized risk identification, risk analysis, and the design of mitigating measures for the risks identified for the projects. The goal of risk management is to identify risks and separate them

from issues as soon as possible to give risk managers the chance to prioritize them and suggest actions to deal with those risks (Kotb & Ghattas, 2017).

Fairley (1994) presents the risk management process in seven steps. This research focuses on the first two steps, which include risk identification and analysis. Risk identification is the process of characterizing the types of risks associated with project implementation, and risk analysis is the process of categorizing risks into high, medium, and low priority based on a risk matrix that considers the likelihood and impact of the risks (Pieplow, 2012). Here, the term likelihood of a risk refers to the possibility that a given event will occur, which is expressed using qualitative terms such as frequent, likely, possible, unlikely, or rare, or quantitative measures such as probability in percent and frequency. On the other hand, the term impact (or consequence) refers to the extent to which a risk event might affect a project, which may include financial, regulatory, and operational impacts (Curtis & Carey, 2012). A risk matrix can cover the full spectrum of risk likelihood and impact, and clustering risks based on their likelihood and impact can support project-related decision-making. Further, a risk register database is maintained to monitor project risk management processes. The purpose of a risk register is to record the details of all risks that have been identified along with their analysis and plans for how these risks will be mitigated. In this research, we refer to the risk register using risk tables that have similar structures and are used in SC proposals.

2.3. Data and Methods

2.3.1. Risk Data

The risk data used in this study were obtained from the SC proposals (SCPs) that are available on the SCM official website. To control data quality, only those SCPs that qualified for funding in the first or fast-track rounds of the SCM were included in this study. The winning proposals were selected by a committee comprised of national and international experts, organizations, and institutions. The committee reviewed and assessed the SCPs submitted by 100 cities. Based on this evaluation, in January 2016 the MoUD selected SCPs from 20 cities as the winners of the first round of the challenge. There were 23 proposals that required minor changes and were asked to be revised and resubmitted for the fast-track round. In May 2016, it was announced that 13 out of the 23 resubmitted SCPs qualified for the fast-track round (G. o. I. Ministry of Housing and Urban Affairs, 2016; Ministry of Urban Development, 2015). The unselected proposals were returned, and these cities may submit an enhanced version of their SCP for consideration in the second round. In summary, the risk data used in this research were obtained from the 33 winning SCPs.

The risk tables in the majority of SCPs identify at least three risks for each of the proposed ABD and PAN projects. In total, 134 ABD risks and 126 PAN risks were collected from the selected SCPs. The risk tables also tabulate four risk characteristics, namely risk description, likelihood, impact, and proposed mitigation methods. The risk description outlines the barriers which may impact the success of proposed projects under SCM. For each risk, cities also provide an assessment regarding the likelihood and impact of the risk. Some SCPs describe likelihood and

impact qualitatively, such as “Low”, “Moderate”, or “High”, while some measure these metrics quantitatively using scores ranging from 0-100. However, there are missing values for likelihood and impact attributes of risks. For risks related to ABD projects, 116 (86%) were supported with information on likelihood and 55 on impact. However, only 54 risks were backed by both likelihood and impact measures in ABD projects. A similar scenario was found with risks related to PAN city projects: 122 (95%) were supported by a likelihood measure and only 46 (36%) had an impact measure. There were 46 (36%) risks that were backed by both likelihood and impact in PAN projects. The SCPs also provide corresponding mitigation measures to mitigate the identified risks. A snapshot of a risk table from one SCP is provided in Annexure 1 (see Figure 16).

2.3.2. Methods

We applied a three-step methodology to analyze the risk data obtained from the selected SCPs. First, risks were categorized using both topic modeling (quantitative) and content analysis (qualitative) approaches. Second, the likelihood and impact of classified risks from step one were analyzed to determine the distribution of these metrics and risk priorities for ABD and PAN projects separately. Finally, the keyword co-occurrence network method was used to determine possible connections between different risk types. The detailed modeling and analysis methods are elaborated as follows.

Step 1: Risk categorization - Several topic models were used to identify potential risk groups from the risk description information from the SCPs, and the classification results were later verified and validated using supervised semantic analysis.

Topic Modeling: Topic models (TMs) were used to cluster risks into subcategories based on the content of risk, including the titles and risk descriptions obtained from the selected SCPs. Topic modeling is an unsupervised classification approach to discover the hidden (latent) topics that are represented by an extensive collection of documents. This process involves the use of Bayesian statistics, optimization algorithms, and linear algebra (Brett, 2012). There are two prevailing TMs: (1) Latent Dirichlet Allocation (LDA); and (2) Non-negative matrix factorization (NMF). LDA is based on probabilistic graphical modeling, while NMF relies on linear algebra. As an unsupervised model, both LDA and NMF do not require any prior annotations or labeling of the documents. All the topics emerge naturally from the statistical structure of the document-word matrix (i.e., each document is represented as a row, with each column containing the count of words in the corpus). Over the last two decades, NMF has received enormous attention and has been successfully applied to a broad range of critical problems in the areas including text mining (Pauca, Shahnaz, Berry, & Plemmons, 2004; Xu, Liu, & Gong, 2003). Compared with LDA, NMF is considered as more appropriate for smaller datasets. This is because LDA uses a Dirichlet prior on top of the data generating process which increases the variability of the model if the dataset is small as the hyper-priors add more variability to the model (Brett, 2012). Both NMF and LDA were tested in this study. NMF showed better performance as the topics generated by NMF are more interpretable and aligns better with previous risk analysis literature when compared with results from LDA. Thus, the NMF model was used to identify themes in risk descriptions. The algorithm of NMF was implemented using Python 2.7s Scikit-learning package (Bakharia, 2016).

In the NMF model, the input risk dataset was defined as matrix A (i.e., document-word matrix) which consisted of *m* risk statements and *n* words, where statements were in rows and words are in columns. The matrix indexes *n* words by *m* risk statements. To obtain *k* topics, we used the NMF model to generate a risk-to-topic matrix W with *m* rows and *k* columns and a word-to-topic matrix H with *k* rows and *n* columns. *k* can be significantly less than both *m* and *n*. On multiplying W with H we obtained the original document-word matrix, A, using Equation (1) (Kuang, Choo, & Park, 2015).

$$A \approx WH \tag{1}$$

where $A \in R^{m*n}$, $W \in R^{m*k}$, and $H \in R^{k*n}$ having only non-negative entries.

W and H can be obtained by optimizing an objective function, updating both W and H iteratively until convergence. The objective function defined in Equation (2) was used to measure the error of reconstruction between A and the product of its factors W and H (Kuang et al., 2015). From the interpretation perspective, W identifies the loading (i.e., likelihood) that each risk statement belongs to different identified topics. The H matrix refers to the likelihood that each word belongs to different identified topics.

$$\min_{W \geq 0, H \geq 0} f(W, H) = ||A - wH||_f^2 \tag{2}$$

Before applying NMF model, the raw descriptions were processed by converting words into stem words (i.e., root words) and removing punctuations and stopping words in the dataset. The

stopping words elimination process was recursive. We started with the standard stopping word list from the Python NLTK package (Bird, Klein, & Loper, 2009) and iteratively added high frequency but not topic worthy words (e.g., risks, implementation, city, etc.) to the list. The challenge of topic modeling is to choose an appropriate number of topics so that it is neither too low (which will generate topics that are overly broad) nor too high (which will result in over-clustering of the data) (Greene, O'Callaghan, & Cunningham, 2014). To obtain an appropriate number of topics, NMF models were run with a target number of topics ranging from 3 to 10 for both the ABD and PAN risk data. The ideal results were obtained with an NMF model that specified five topics. The iterations with less than five topics were insufficient, while iterations with six or more topics result in repetitive topics.

Semantic Analysis: Semantic analysis was used to qualitatively verify and validate risk categories identified by NMF model. Semantic content analysis is the process of creating themes (categories) that identify the main subjects and dimensions in the material under study (Özdem, 2011). The approach was applied to the risk statements in the SCPs to determine the keywords, which were later grouped to generate risk categories (shown in Table 10 in Annexure 1). The risk categories identified using semantic analysis were then compared with categories identified by the NMF model and those found in the literature to arrive at the final risk classification results. After identifying the risk categories, we computed the occurrences/frequency of the identified categories to determine the prevalence of different types of risks across projects.

Step 2: Priority Analysis - We developed risk priority matrix for classified risks based on their likelihood and impact as stated in the SCPs, as shown in Table 1. The risk likelihood and impacts

were grouped into three categories, i.e., Low (percentage ranging from 0-33), Moderate (percentage ranging from 34-66), and High (percentage ranging from 67-100). In the practice of risk management, the classification of risk priority zones is primarily determined by the objective of risk management and there are no standard methods. Markowski and Mannan (2008) suggest that the selected number of zones in the risk priority matrix should be sufficient to support timely categorization of risks, but not excessive such that it increases the complexity of risk management. In this study, risk likelihood and impact were divided into three subcategories, as the majority of the SCPs used such a classification method. We then generated three risk priority zones (shown in three different colors: green, orange, and red in Table 1) based on the combination of likelihood and impact category. The green cells represent the risk zone with the least priority, orange cells are the ones with moderate risk priority, and the red zones refer to high priority risks that may require urgent attention and more strategic management. Only the risk statements with both likelihood and impact attributes were considered for the priority analysis.

Table 1: Risk Priority Matrix.

		Likelihood		
		Low	**Moderate**	**High**
Impact	**Low**	Low-Low	Low-Moderate	Low-High
	Moderate	Moderate-Low	Moderate-Moderate	Moderate-High
	High	High-Low	High-Moderate	High-High

Step 3: Risk Co-occurrence Analysis - The risk co-occurrences were analyzed to explore whether the risk connections identified in the existing literature were also applicable to India. In recent years, researchers have used keyword co-occurrence networks (KCNs) frequently for

knowledge mapping. KCN involves identifying nodes and edges in knowledge mapping, where, each keyword is represented as a node and each co-occurrence of a pair of words is represented as an edge. The number of times that a pair of words co-occurs in multiple articles (risk statements in this case) constitutes the weight of the edge connecting the pair (Radhakrishnan, Erbis, Isaacs, & Kamarthi, 2017). The network constructed using keywords (nodes) and edges (co-occurrences of keywords) represents cumulative knowledge of the field being explored. KCN has been used to uncover meaningful knowledge components and insights based on the patterns and strength of edges between keywords that appear in the literature, reports, and other documents (Radhakrishnan et al., 2017). The co-occurrence networks created are used to provide a graphic visualization of potential relationships between individuals, concepts, or other entities represented within written materials. The generation and visualization of co-occurrence networks has become practical with the advent of electronically stored text amenable to text mining.

We applied KCN to identify the risk co-occurrences for both ABD and PAN projects. A graph, G, was first created with identified risks as nodes N, and edges, E, between risk nodes that were discussed in the ABD or PAN risk statements. The weight of the edge was determined by the frequency of the risk co-occurrence. The higher the co-occurrence of the risk categories in SCPs, the higher the weight of the edge between the risk nodes. We then visualized graph G using Gephi 0.9.1. In the visualization, the width of the edge reflects the weight of the edges (i.e., the number of times it co-occurred with other risks) and the size and color of the nodes refer to the degree of nodes (i.e., the bigger the size and the darker the color, the more frequently that node (risk) occurs in the risk statements).

One limitation of this study is the reliance on risk-related information in the SCPs that were developed by city municipalities. These SCPs were not prepared for research purposes, but for the SCM selection process and therefore lacked detailed information on risk definitions, the likelihood of a risk occurring, and the impacts of the risks. This research used text analysis that involves making the best educated guess at some of the most likely interpretations that might be made of the text when examining the documents. To ensure the trustworthiness of this study, we systematically and quantitatively analyzed the SCP documents using Topic Modeling and complemented the results by performing a semantic analysis on the documents.

2.4. Results

2.4.1. Risk Categorization Results

Eight risk categories were identified by synthesizing results from the NMF model, semantic analysis, as well as prior studies. We found that results from NMF and semantic analysis complement and validate each other. NMF clusters the risks based primarily on the word frequency, and as a result, the model tends to neglect categories/topics which occur less frequently. We identified five risk categories using the NMF model. While seven possible risk categories were extracted using the semantic analysis method. Semantic analysis complements the NMF model. However, it is time-consuming and has been recognized as subjective. Further, the identified risks were cross-compared with identified risks from previous studies and were narrowed down to eight by grouping the related risks. For example, Stakeholders risks were grouped with Non-financial resource management risks, as the statements described the Stakeholders risks as a lack of coordination or support from stakeholders, which may lead to

delays in resource and materials procurement. Figure 5 shows occurrence frequency (in percentage) of identified risks by project types.

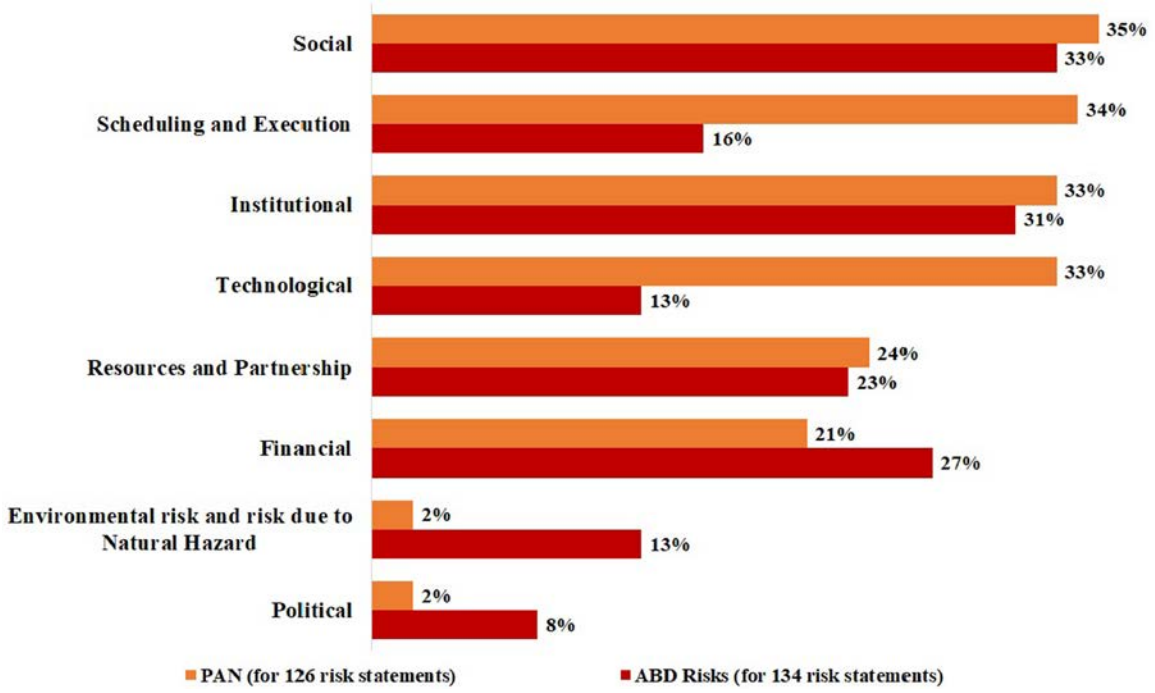


Figure 5: Risk percentage for all eight risks for ABD and PAN Projects.

Social Risk: Social risks are most frequently mentioned in SC risk statements and are often referred as citizen participation, exclusion, or resistance in the SC literature. Most Social risks result from citizens' reluctance to pay for proposed services and opposition from citizens who may be negatively impacted by a project. In addition, densely populated urban regions may be unable to implement rigid eviction measures or enforcement of other temporary restrictions. Further, unplanned informal settlements across the city makes it difficult to expect any serious engagement from citizens residing in these settlements (Hoelscher, 2016). In the SCPs for 33 cities, Social risks occurs most frequently and is mentioned in 33% and 35% of statements from ABD and PAN projects, respectively.

Institutional Risk: Institutional risks are more often referred to as governance, approval, or legal and ethical challenges in the SC literature. Institutional risk was considered as one of the major risks that result from poor collaboration among state and city governments and delays in amending old regulations. The lack of operational and technical capacity of urban local bodies may prevent projects from taking off. The importance of Institutional risk can be understood by its occurrence in 31% of the ABD statements and 33% of PAN statements. The occurrence of Institutional risk is relatively higher (in terms of percentage) for PAN projects.

Financial Risk: Financial risks are related to funding problems that may delay project implementation and may even hamper project existence. This may include a lack of funding due to a delay in sanctioning funds from the central/state government and private partners and difficulty in raising funds via tax. Other financial factors, such as failure to accurately estimate project costs, may also jeopardize the successful implementation of projects. Under the SCM, cities raise funds through the convergence of schemes and integration of public and private sectors to increase the financial capacity. However, such funding mechanisms can be challenging for municipalities, as the availability of funds and proper convergence with other schemes are interdependent. Financial risk is the third most occurring risk for ABD projects (27%), whereas it is addressed less frequently for PAN projects (21%), which indicate that financial risks tend to prevail in the implementation process of small-scale projects.

Partnership and Non-financial Resource Management Risk: Partnership and non-financial resource management risks refer to risks associated with multiple stakeholders, asset ownership, and availability and quality control of raw material/services. Cities, in developing countries like

India, have limited capacity to implement and maintain large-scale projects. Hence, SC projects are envisioned to face some additional implementation challenges, such as the lack of IT connectivity, unfavorable procurement conditions due to the lack of local expertise/service providers, and low service quality. While this risk is identified in 25% of the proposals, it remains essential for cities to develop detailed management plans for procurement and execution processes.

Scheduling and Execution Risk: Scheduling and Execution risks are mostly referred to as strategic challenges and in some cases as outcomes of other challenges in the SC literature. Several studies note that a successful SC project needs to be completed in time which requires well planned schedules for several stages of project execution. Ill-designed completion schedules may lead to significant delays in project implementation. On the other hand, Execution risks stem from the complexity and scale of a project, including the integration between ongoing and proposed projects, and lack of holistic project planning. Large-scale projects are more likely to be plagued by Scheduling and Execution risks since they involve more collaborators and exhibit a higher level of complexity. Therefore, these risks are more frequently mentioned in PAN statements (34%, i.e., the second most frequently mentioned) compared to ABD statements (16%).

Technological Risk: Technological risks are risks associated with the technology selection, its availability, and implementation of selected technology. The digital divide is one of the major concerns with implementing smart projects in areas where technology penetration has been low, especially Tier 3 or lower cities in India. Additionally, many Indian cities also have insufficient

cyber and physical infrastructures, regulations, and knowledge pools to support the wide adoption of new technology, limiting the impact of ICT projects. The Technological risk tends to prevail in PAN projects (33%) and is only mentioned by 13% of the ABD projects. This is because PAN projects are more technology intensive, larger in scale, and require a higher level of technology awareness, acceptance, and market penetration for project implementation.

Environmental Risk and risk due to Natural Hazards: Several SCPs suggest the implementation of SC projects may also be hampered by environment conditions, such as local climate (e.g., rainy season) as well as unanticipated natural hazards (e.g., earthquakes, cyclones, tsunami, etc.). Given that the probability of these extreme events is small, the occurrence of environmental risk in ABD and PAN projects is lower in comparison to other risks.

Political Risk: Political risks are those, which arise due to a lack of synergy between the political party in the center and the state; and/or a change in leadership during implementation which may result in strategic changes that further affect project implementation. Additionally, cities situated on India's border mentioned cross border terrorism and poor relationships with neighboring countries as one of the barriers affecting project implementation. Around 8% of ABD statements and 2% of PAN statements mention Political risk indicating a higher political risk observed in ABD projects than PAN projects.

2.4.2. Risk priority

Figure 6(a) and Figure 6(b) show the overall distributions of risk priority for ABD and PAN projects, respectively. The percentage of risks associated with both ABD and PAN projects,

lying in the High-priority zone, is higher than the percentage of risks lying in Low- and Moderate-priority risk zones. Among all ABD risk statements, 20%, 29%, and 51% of the risks fall into Low, Moderate, and High priority risk zones, respectively. Whereas, the percentage of PAN risks lying in High-priority risk zone is even higher with 69%. There are only 21% and 10% of PAN risks lying in Moderate- and Low-priority risk zones. This is because PAN projects are larger, rely heavily on technology implementation, and are considered to be more challenging for cities to implement when compared with small-scale ABD projects. Most Political and Environmental risk statements are not accompanied with sufficient likelihood and impact information. Therefore, we excluded the Environmental and Political risk for priority analysis.

The priority analysis presented similar observations for both ABD and PAN risk statements, including, Institutional risk recognized as a High-priority risk, not only for the cities belonging to Tier-II (population between 500,000-5,000,000) and Tier-III cities (population less than 500,000), but also by the state capitals, such as Bhubaneswar and Bhopal. Further, Social and Financial risks prevail in both ABD and PAN projects and are considered High-priority risks in more than half of the proposals. Comparably, Partnership and Resource Management risk is categorized as either moderate or high priority risk by cities, and none of the cities identified it as a low priority risk for PAN projects. A lack of infrastructure and service providers, combined with the poor quality of raw materials, is seen as one of the most significant barriers to implementing small- or large-scale projects.

The risk priority results highlight several dissimilarities in ABD and PAN projects. Scheduling and Execution risks are perceived differently in ABD and PAN projects and are typically

considered as more critical in PAN projects. For instance, PAN project proposals from large cities, such as New Delhi consider most scheduling issues as high priority risks. However, few ABD risk statements mention Scheduling and Execution risks as High-priority risks. This finding could be associated with the scale of projects since it is comparatively easier to manage small-scale projects. Like Scheduling and Execution risk, Technology risk is perceived differently for ABD and PAN projects. ABD projects use technology but not as intensively as PAN projects. As a result, Technology risks are considered to have a lower risk priority in ABD projects compared with PAN projects.

This risk priority analysis suggests that frequently mentioned risks may not be the ones that require urgent attention. For example, Institutional, Social, and Scheduling risks occur more frequently in ABD and PAN risks, but are distributed across low, medium, and high categories. Whereas, Financial and Partnership and Resource Management risks occur less frequently, but are mostly identified as high and moderate risks. Even the bigger cities (in terms of size and population) that seem to have better access to funds, resources, and technology, have also identified these risks as a high priority. Funding and Partnerships are some of the initial components for successfully implementing SC projects and thus need more attention by project implementers and city officials.

Figure 6: Risk priorities for (a) ABD projects (top image) and (b) PAN projects (bottom image) based on their likelihood and impact.

Note: The colors used in the bar chart represents Green: Low priority; Orange: Moderate priority; Red: High priority.

2.4.3. Risks Co-occurrences

The co-occurrences networks for ABD and PAN projects are illustrated in Figure 7(a) and Figure 7(b), respectively, highlighting the most co-occurring risks in both the risk networks (with frequency of co-occurring risks on the edges). Similar risk co-occurrences are observed for ABD and PAN projects, but the most commonly co-occurring nodes varies. The most frequently co-occurring risks in ABD projects are Partnership and Resource Management risks with Financial risk (15 times), indicating the importance of funding to entice private partners and service providers. Whereas, Scheduling and Execution risk most frequently co-occur with Technology risk for PAN projects (19 times), which reflects the scale and tech-savvy nature of these projects.

The risk co-occurrences in ABD and PAN networks are differently distributed. In the ABD risk network, Institutional risk most frequently co-occur with other risks, such as Social, Partnership and Resources, Scheduling and Execution, Technological, and Financial risk. A possible connection between Institutional and Scheduling and Execution risk may be a delay in decision making by various government agencies due to overlapping roles leading to the delay in approvals across departments. This may also impact the timely execution of projects and increase costs. In addition, too many regulations may constrain new partnerships for resources and technology related services which show a connection between Institutional risk with Partnership and Resources and Technological risk. In contrast to the ABD risk network, Scheduling and Execution risks tend to co-occur frequently with other risks in the PAN risk network. PAN projects are heavily dependent on the availability of technology resulting in greater number of

co-occurrences between Scheduling and Execution risk and Technology risks. Furthermore, high co-occurrences of Scheduling and Execution risk with Institutional risks can be connected with delays in project completion caused by delays in decision making by local agencies. Additionally, a lack of funds and/or delay in sanctioning of funds for a project further delays project completion, which helps explain the connection between the co-occurrences of Scheduling and Execution risks and Financial risks.

Although risk co-occurrences vary by project types, Institutional risk tends to frequently co-occur with Scheduling and Execution risk, Social risk, Partnership and Resources risk, Technological risk, and Financial risk in ABD and PAN projects. This may correspond to the complex structure of city-level governance. Local government agencies in India have overlapping duties. As a result, interactions among different departments and sub-units are highly interconnected and interdependent causing delay in the approvals and decision making in project implementation. Lastly, the keyword co-occurrence analyses indicated similar risk co-occurrences found in developed nations. For example, frequent co-occurrences of institutional risks with other risk categories in addition to co-occurrences of partnership and resources risks with financial risks (Techatassanasoontorn & Suo, 2010).

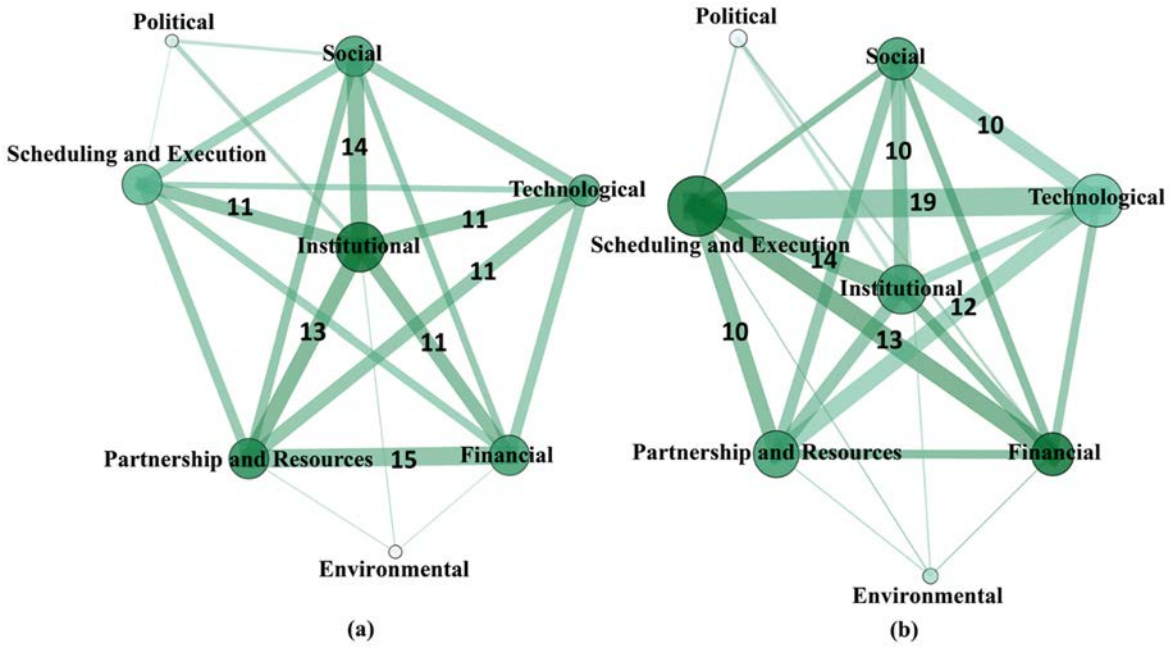


Figure 7: Risk co-occurrences identified in (a) ABD projects and (b) PAN projects.

2.4.4. Comparing Risks in Developed and Developing Nations

There are similarities as well as discrepancies between risks associated with SC project implementation in developing and developed countries. Both countries share risks, such as Social and Institutional risks, risks associated with the sustainability and scalability of the SC projects, and cross-sector collaboration risks. Social risks are not unique to the India SCM, as studies suggest that such risks also exists in developed nations due to absent or limited public engagement (Cowley, Joss, & Dayot, 2018) or the lack of interest among citizens in SC projects (Lovell, 2017). Additionally, Institutional risks are also observed in SC projects from 25 European cities (Pierce & Andersson, 2017). This suggests that SC project implementation in developing and developed nations may be impeded by uncoordinated efforts and a lack of appropriate enforcement of regulations and policies at the city level (Rana et al., 2019). Further, several identified risks from the SCM, such as Technological risks, are associated with the

sustainability and scalability of SC projects (i.e., the ability to continue or scale up a project). To this end, the Government of India, for the first time, experimented with integrating funds across the national missions such as the SCM and the Swachh Bharat Abhiyan, which proved to be challenging to manage. A similar concern related to integrating funds across programs is also shared by funders, policy makers, and investors in Europe (Zanella, Bui, Castellani, Vangelista, & Zorzi, 2014). Finally, the risk in cross-sector collaboration, especially public-private partnerships (PPPs), is also found in projects in both developing and developed nations (Hartemink, 2016). The public sector typically relies on the private sector to bring in expertise, finance, and technology capabilities to support SC projects, but there is a disconnect between expectations of private sector and offerings of the public sector.

Despite some implementation risks being shared by SC projects in the two contexts, the priority and severity of the risks may vary. For instance, technology risks in India, especially in Tier-II and III cities, were related to lower technology penetration levels, the limited availability of the latest technologies, their capacity, and an absence in data-sharing standards. In contrast, Zanella et al. (2014) found that Amsterdam, Philadelphia, Chicago, and New York faced technology risks such as non-interoperability challenges in implementing smart solutions. Additionally, some researchers also highlight technology risks, such as data security and privacy issues in SC projects in developed countries (Botta, De Donato, Persico, & Pescapé, 2016). The priority of resource management also varies across different nations, as the risk is not considered as critical for developed nations as it is in Indian SC projects. For instance, the limited availability of land and lack of infrastructure and service providers, combined with the poor quality of raw materials,

are considered to present one of the most significant barriers to implementing small- or large-scale projects in India.

Given the similarity in SC risks that exist between developed and developing nations, several successful risk mitigation measures used in developed nations could be adapted and applied in the Indian context. Table 2 summarizes the proposed mitigation measures described in the SCPs (left column) and the strategies implemented in some of the successful SC cases in developed countries (right column), which may be adapted to address risks for SC project implementation in developing nations. More research should be devoted to understanding and addressing challenges that are unique in developing nations.

Table 2: SC mitigation strategies in response to the identified SC risks.

Suggested Risk Mitigations (from SCPs)	**Mitigation Measures from other SC Cases**
Social Risks	
• Initiating a structured dialogue process with citizens to increase awareness and promote conflict resolution. • Enhancing project transparency by regularly updating stakeholders (citizens) on the progress of projects.	• Identifying and evaluating the current channels used for citizen awareness to ensure that citizens are informed about the SC projects that are being implemented (or to be implemented). • Empowering citizens by involving them in designing SC projects and policies (Granier & Kudo, 2016). • Approaching SC development by combining top-down and bottom up strategies (Mora & Deakin, 2019) will result in combining the collective intelligence of all the affected stakeholders.
Institutional Risks	
• Realigning organizations and forming commissioning task force committees and SPVs for each SC. SPVs are limited companies led by a full time Chief Executive Officer and	• Integrating management decisions taken by municipal officers at various levels to ensure accountability (Boykova, Ilina, & Salazkin, 2016; Mora et al., 2019).

Suggested Risk Mitigations (from SCPs)	Mitigation Measures from other SC Cases
have representation from Central Government, State Government, and the Urban Local Body (ULB) that can implement the SC projects at the city level (Ministry of Urban Development, 2015). SPVs are seen as a potential solution to: a) ensure coordination between different agencies; b) bring financial stability; and c) strengthen partner networks for resource management that could improve the timely implementation of projects.	• Developing reporting routines/schedules which should not only be seen as disciplinary strategy but should also trigger learning between and within administrative levels (Fromhold-Eisebith & Eisebith, 2019).
Financial Risks	
• Building public-private partnerships for mobilizing funds, steering and synchronizing the convergence schemes • Encouraging self-sustainable projects to alleviate this risk	• Replicating or adapting successful strategies showcased through SCs in India such as Bhopal, which proposed projects that are self-sustaining or revenue generating (K. Kumar, 2018). • Identifying present and prospective income streams to assure stakeholders about repayment options to ensure financial sustainability of projects (Hartemink, 2016; McClellan, Jimenez, & Koutitas, 2017).
Partnership and Non-financial Resource Management Risks	
• Conducting industry consultations with relevant technology providers at various stages of the project life-cycle to maintain the quality of resources used and consequently control the quality of projects delivered. • Relaxing regulations to engage private sectors and local businesses in non-financial resources supply and management.	• Incorporating regulations and standards into contracts with stakeholders/partners to ensure quality work (Ojo et al., 2014). • Developing new collaborations with stakeholders and a systematically dividing tasks between local government (who may lead general aspects of SC planning), research institutions (who may offer technology competency), technology providers (setting up executing SC platforms and infrastructures), and consulting firms that help manage all project/implementation processes (Dameri, 2017; Meier & Portmann, 2017). • Embedding SC processes in wider regional, national, and global settings of infrastructure procurement, regulatory framing and product or service provision (Fromhold-Eisebith, 2017).

Suggested Risk Mitigations (from SCPs)	Mitigation Measures from other SC Cases
Scheduling and Execution Risks	
• Implementing plans with phased planning and performance-based payment incentives. • Strategizing projects which can be bulk ordered to one vendor for collective projects.	• Scheduling and Execution risks are more often discussed as an outcome of financial, institutional, and/or resource management risks. Therefore, the implemented mitigation measures are suggested in their respective sections.
Technological Risks	
• Upgrading software and hardware up-gradation. • Human resources training and capacity development to better adopt new technologies. • Adopting Open source technology.	• Developing systems that are resistant to cyber-attacks, particularly the critical infrastructure like smart meters (Zanella et al., 2014).
Political Risks	
• Increasing the involvement of political parties in the city planning processes.	• Having support from local government such as a strong local government partner as a key strategic player can help in better aligning SC initiative (Hartemink, 2016).

2.5. Conclusion

This study presents a constructive and progressive outlook on the current Indian SCM by providing a framework for risk identification and analysis in implementing SC projects. This study contributes to the SC project implementation literature by providing a systematic risk analysis in a developing country to help SC managers in prioritizing the identified risk with respect to the project scale.

This study classified the SC implementation risks into eight categories, namely, Social, Institutional, Partnership and Resource Management, Scheduling and Execution, Financial, Technology, Political, and Environmental. Projects across scales share similar categories of implementation risks. However, ABD (small-scale) and PAN (large-scale) projects face different

management challenges regarding risks priorities and their co-occurrences. The findings indicate that the most frequently observed risk may not be the one that needs immediate attention by the city officials, and therefore risk identification and priority analysis together present a more holistic picture. Moreover, the risk co-occurrences highlighted in this study indicate possible connections between the risk categories. These risk co-occurrences may affect the implementation of SCM projects suggesting different mitigation measures may need to be developed to manage small and large-scale projects, respectively. Risk categories found in the India SCM are similar to that found in the cities of developed nations. However, the frequent occurrences of social, institutional and partnership risks over technology and financial risks indicate that risk priorities may vary for developing and developed nations. With existing poverty levels, lack of physical infrastructure, and fewer technology vendors, resource and partition risks can have severe impacts on project implementation in developing nations. Furthermore, this research highlights several risk mitigation strategies from the existing smart cities cases that can be implemented in a developing nation's context.

This research can be advanced in several directions. First, the SC project implementation risks are identified using "stated" data from the SCM proposal reports, which were submitted before project implementation. Therefore, more knowledge can be gained by collecting and analyzing post-implementation data from SCM experts and practitioners in India. Second, this study only examined the co-occurrence of SC risks. Future research may be dedicated to unveiling the causal relationship among risks to support risk management policies. Finally, in-depth case

studies in developing nations are needed to develop effective risk mitigation strategies for the developing nation context.

Chapter 3: EXPLORING RISKS IN IMPLEMENTING SMART CITY PROJECTS IN THE CITIES OF KAKINADA AND KANPUR

Abstract

With an increasing number of smart city initiatives in developed as well as developing nations, smart cities are seen as a catalyst for improving the quality of life for city residents. Several developing countries such as India and China have invested intensively in these initiatives. However, the current understanding of the risks that may hamper the successful implementation of smart city projects remains limited. Through this research, we examined the risk landscape in implementing smart city projects in two proposed Indian cities, Kakinada and Kanpur, by interviewing 20 professionals from industry and local government who were closely associated in implementing smart city projects. We identified seven risks, namely, resource management and partnership, institutional, scheduling and execution, social, financial, political, and technology using thematic analysis. Further, we modeled their interrelationship using causal mapping techniques. Our results suggested that the two types of professionals interviewed had different risk priorities. We also found closely connected risks such as institutional risks affecting several other risks directly and indirectly. These findings suggest that risk mitigation strategies need to take a comprehensive view towards all risks and their interconnections instead of managing each risk in isolation.

Keywords: Smart Cities, Smart City Mission, Risks, and Risk causal mapping

3.1. Introduction

Over the past decade, the notion of a 'Smart City' (SC) that leverages the power of Information and Communication Technologies (ICT) to enhance resource management has been gaining attention around the world (Angelidou et al., 2018). Significant SC investments are being made by both developed and developing nations (Martin et al., 2018), including the United States, India, Australia, China, the United Arab Emirates, and South Korea (Fromhold-Eisebith & Eisebith, 2019; Gupta & Hall, 2017; Martin et al., 2018; Smith, Pathak, & Agrawal, 2019). The popularity of the SC concept can also be gauged by the fact that recent rankings, competitions, initiatives, challenges, and research projects are all launched using the label "Smart". Technology companies, universities, cities, and research centres also desire to be part of the "Smart" movement (Desdemoustier, Crutzen, & Giffinger, 2019).

Policy makers, leaders, and researchers envision investments in SCs as a response to the challenges presented by rapid urbanization (Yigitcanlar et al., 2018), and are under enormous pressure to transform their cities into SCs (Techatassanasoontorn & Suo, 2010). However, several researchers have noted that even after decades of investment, SC transformation remains ad-hoc and fails to achieve the desired outcomes (Yigitcanlar & Lee, 2014). One reason for this failure is that SCs are supposed to drive societal and environmental transformations, in addition to the complex integration of technology, governance, and partnerships (Albino, Berardi, & Dangelico, 2015; Andrea Caragliu, Del Bo, & Nijkamp, 2011), placing too many objectives on one effort. Further, SC initiatives often fail to foresee the implementing challenges/barriers/hindrances/risks in planning SC projects due to a lack of understanding of the risks associated with developing a SC.

SC risks are not just limited to technology (Bawany & Shamsi, 2015; Wenge, Zhang, Dave, Chao, & Hao, 2014) and financing (Hamilton & Zhu, 2017; Vadgama, Khutwad, Damle, & Patil, 2015), but include challenges related to local governance, the social makeup, and political leadership in the city. Additionally, SC development using a brownfield approach to change, i.e., retrofitting or redevelopment of existing infrastructure, adds to the existing challenges. Moreover, SC implementation risks become even more crucial in a developing nation's context because of widespread infrastructure deficiencies, high technology costs, a scarcity of skilled labor, and the evolving nature of social and institutional organizations (Hamza, 2016).

With the scale of investment and resources devoted towards SC initiatives, it is important that SC initiatives are successfully implemented. The success of planned (and currently being implemented) SC initiatives depend heavily on the strategic implementation of risk management plans that require a holistic understanding of SC risks that include, risk identification, frequency of occurrence, and causal linkages with other risks (if any). However, the current SC literature lacks a holistic understanding of SC risks (Angelidou, 2015; Rana et al., 2019) especially in the context of a developing nation. Against, this background, this study investigates SC implementation risks in the cities of Kakinada and Kanpur – currently undergoing SC development using a retrofitting approach – under the Indian Smart Cities Mission. Specifically, this research poses two questions: **1) What implementation risks are present in the cities of Kakinada and Kanpur adopting a retrofitting model of SC development? and 2) Are these risk categories connected?**

In this research, feedback from officials (from government and private consultancies) closely associated with SCM execution in the two cities of Kakinada and Kanpur was incorporated in

the analysis. In addition, barriers to SC implementation were identified from the literature. The findings from this study provide insights related to understanding the SC risks facing policymakers/planners in developing and underdeveloped countries working to advance successful SC initiatives.

In order to understand the risk landscape in India's Smart Cities Mission, this study provides an overview of the Smart Cities Mission, highlights the findings and research gaps from the current literature on SC implementation, describes the data set and methodology used, and discusses the major findings.

3.2. Smart City Mission

Over the past two decades, the Government of India (GoI) has taken up several initiatives to manage rapid urbanization in the form of programs such as the Mega City and Jawaharlal Nehru National Urban Renewal Mission (JNNURM). These programs have mainly focused on providing basic infrastructure services and utilities to the cities without paying much attention to advancing sustainability. However, some policy experts have argued that these programs, specifically, JNNURM failed to achieve significant renewal because of implementation barriers that included the lack of stakeholder participation in the planning process, the lack of political support for housing and slum development projects, and the lack of capacity and expertise among local officials (An, 2015).

Based on experiences from previous missions, there was a need to shift the way urban infrastructure was managed in India. As such, the GoI launched a national initiative called the Smart Cities Mission in 2015 (Ministry of Urban Development, 2015). The purpose of the SCM is to promote economic growth and improve the quality of life through the design of the Smart Cities Challenge (Aijaz & Hoelscher, 2015). To take part in this challenge, Indian

cities competed for central government funding to implement SC strategies by submitting their Smart City Proposals (SCP) to the GoI. This mission pioneered the use of three new forms of urban development in India: 1) the use of a competitive framework to advance a major urban development mission via three components (Ministry of Urban Development, 2015): (a) Area-based developments that will transform existing areas, including slums, into better-planned ones, by retrofitting and redevelopment thereby improving the liveability of the whole city; (b) Pan-city developments that envisaged the application of selected smart solutions to existing city-wide infrastructure; and (c) greenfield development; 2) engaging citizens in developing a city's vision; and 3) conceptualizing Special Purpose Vehicles (SPV) to better manage the mission's activities at the local level. Four years from its conception, 100 cities have been selected to implement their proposed smart activities through various rounds of the mission (Ministry of Housing and Urban Affairs, 2018). Out of these 100 cities, more than 90% of the cities belong to Tier-II (with a population between 500,000 and 5,000,000) and Tier-III (with a population of less than 500,000) cities (Press Trust of India, 2015), which necessitates studying the SC implementation risks prevalent in these cities.

To date, the SCM has been examined by several researchers who have explored the mission's narrative (Bhattacharya, Rathi, Patro, & Tepa, 2015; N. M. Kumar, Goel, & Mallick, 2018), conducted a preliminary examination of the projects (Gupta & Hall, 2017; Smith et al., 2019), studied the execution of the mission (Aijaz & Hoelscher, 2015), explored the challenges facing the SCM (Gupta & Hall, 2017; Rana et al., 2019), and highlighted a range of critiques of the SCM (Ayona Datta, 2015). However, the emerging literature on SCs in India currently lacks a discussion on how to look at the mission more constructively, providing insights into how the mission could become more successful in its delivery of SC projects.

3.3. Literature Review

3.3.1. Project success and risks

A conventional project needs to realize three objectives in order to be successfully implemented – i.e., to complete the work in accordance with the budget, schedule, and performance requirements (Nicholas & Steyn, 2008). However, most projects are carried out under different and uncertain conditions (Fourie, 2011), posing risks that may lead to the failure of projects. A risk can be defined as "an uncertain event or set of circumstances that, should it occur, will have an effect on the achievement of the project's objectives" (Simon, 1997). Risk may come from multiple sources, including political, economic, societal, technological, and environmental risks, and if these risks are not managed properly they may lead to eventual project failure, severe project delays, poor quality, and/or significant cost increases (Pheng, 2018). With increasing size and complexity of conventional projects such as construction, the complexity of risks also increases leading to greater chances of project failure (Nicholas & Steyn, 2008).

Previous studies on project management have identified risks in conventional and large-scale projects (Sotoni, Qefalia, & Barolli; Van Heerden, 2013). However, these risks need to be further tailored with respect to SC projects, since they typically involve a mixture of construction, infrastructure implementation, and ICT integration. Further, greater diversity of skills, meaningful citizen and stakeholder involvement, and human resources with sufficient technological capability are required to meet the goals of successfully implementing a project (Kummitha, 2018). Further, Kim (2016) highlights that the complexity of the stakeholder ecosystem diminishes the potential of SC initiatives and may even discourage future

improvements because of poorly managed conflicts between the stakeholders. Therefore, it is important to identify the various risks that are present in SC implementation.

3.3.2. Smart City Risks

With increasing scholarship on smart cities and implementation of projects, the SC concept has seen a shift from “an end” to “the means” with regards to making cities more liveable. However, a “smart city” is still considered a fuzzy term which ranges from “mesh metropolitan information and communication technology” infrastructure (ICT) (Mahizhnan, 1999), to describing various ICT attributes in a city (Albino et al., 2015; Andrea Caragliu et al., 2011; Chourabi et al., 2012; N. Komninos, 2011), to measuring the footprint of smartness using various frameworks/indexes (Giffinger et al., 2007). While the SC scholarship is rich in theorizing the benefits and opportunities of SCs, there have been fewer studies in highlighting the prevalent SC implementation risks (mostly referred as challenges/barriers) (Pierce & Andersson, 2017). However, recently, there is an emergence of a broader and less critical literature analyzing actual smart initiatives on ground (Bakıcı, 2013; Garau, 2014; Grimaldi & Fernandez, 2017; Komninos & Tsarchopoulos, 2013; Maier, 2016; Nam & Pardo, 2011). Primarily these studies focus on SC initiatives that are being implemented in Europe and North America (with notable exceptions of studies focused on Brazil (Gaffney & Robertson, 2018), India (Rana et al., 2019), South Korea (Yigitcanlar & Lee, 2014), and Australia (Bulkeley et al., 2016). Furthermore, studies by (Martin et al., 2018) and (Kummitha, 2018) have indicated tensions/concerns around implementing smart initiatives and offered suggestions to policy makers and practitioners on how to build inclusive smart cities and not just technologically smart cities.

Previous studies have pointed out that the characteristics of SC initiatives vary from place to place and depend on various contextual factors such as development level, available resources, urgent urban needs, a city's vision, and the type of SC development site (green-field or brownfield) (Monzon, 2015; Myeong, Jung, & Lee, 2018). Consequently, these characteristics may also influence the challenges in implementing SC projects. Researchers Ojo et al. (2014) and Monzon (2015) have described the broad spectrum of factors that are associated with successful project implementation in their studies, but they do not provide specific details about potential challenges. However, some studies have focused on key factors such as finance and human resources (Budde & Wansink, 2010), technology (Anthopoulos & Fitsilis, 2009; Harrison et al., 2010; Nam & Pardo, 2011), policy and institutional reforms (Bellamy & Taylor, 1996), local governance (Belissent, 2011; Chourabi et al., 2012), and citizen participation (Giffinger et al., 2007), discussing these as key characteristics to become smart and not really addressing them as challenges/barriers. Additionally, researchers such as Angelidou (2015) and Yigitcanlar (2015) argued that the SC literature lacks a systematic analysis of challenges in implementing SC projects. Further, Van den Bergh and Viaene (2015) expressed a similar view, emphasizing the importance of incorporating the experiences of existing SC initiatives in future research.

Recently, several industrial surveys have been conducted to understand the challenges surrounding the implementation of SC projects, and these surveys highlight the necessity of technologically aware human resources, visionary leadership, smarter citizens, and strong institutional mechanisms (International City/County Management Association, 2016; Smart Cities World, 2018). The worldwide survey launched by Smart Cities World (2018) (in association with Philips) to understand and identify the key attributes and perceptions about SC implementation highlighted budget limitations as a major implementation challenge.

Further, the survey findings quoted one SC implementation manager as stating that the challenges facing SC projects were “Not within the scope of business as usual,” due to a lack of capacity and overburdened city managers. While these surveys capture a range of challenges, they do not identify any linkages between them. Nevertheless, most surveys and studies indicated earlier are focused on SC challenges in a developed nation context.

Unlike cities in many developed nations, cities in developing nations such as India are producing more negative externalities because of increasing demographic pressures, rapid urbanization, and environmental changes. Moreover, these cities face challenges such as informal development due to an increasing number of urban poor, urban insecurity, scarcity of resources, and lower penetration of technology (Pathak, 2016). These challenges can undermine the implementation of any urban project including SC projects. Additionally, most proposed Indian smart city projects consist of brown-field development – i.e., they are adopting redevelopment or retrofitting approaches that may further complicate the project implementation with existing old and unplanned infrastructure and a complex ecosystem of stakeholders. According to Smith et al. (2019), out of 51 cities they examined under the SCM, only 10 were developed from greenfield cities while others were adopting brownfield development approach. Therefore, besides becoming ‘smart’, existing cities have many issues related to day to day functioning of the city that must be addressed, and which competes for a share of the city’s resources. These factors further necessitate exploring the challenges present in implementing SC projects in a retrofitting or a redevelopment setting in a developing nation context.

Recently, Gupta, Zhang, and Hall (2019) found that with respect to developing nations such as India, local government risks, social risks, resource management and partnerships risks

may need more attention than only focusing on financial and technology risks for the successful implementation of SC projects. Their study was based on the analysis of risks mentioned in the Indian SCPs for proposed Area-based and Pan city projects. Further, Gupta et al. (2019) identify the prevalence of co-occurrences between SC risks in the Indian SCM, but caution that these need further validation.

On reviewing SC and project management literature, it was found that there has been limited attention paid to the risks present in implementing SC projects, particularly in a developing nation context. Furthermore, the complex and intertwined nature of these risks need further exploration by systematic and comprehensive analysis. Through this study, we further the exploration of risks in SC projects in Indian cities, previously conducted by Gupta et al. (2019), to explore the risk landscape and identify and validate any risk linkages by interacting with experts closely associated with SCM.

3.4. Data and Methodology

3.4.1. Data

Since the research goal is to investigate the risks associated with implementing SC projects in India, it was important to interact with experts who were closely associated with the Indian SCM. Purposive sampling was used to select participants for this research. Following this guideline, interviews were conducted from October 2018 to January 2019 with two groups of experts: government officials and industry professionals/consultants who are working on SCM projects in Kanpur and Kakinada.

3.4.1.1. Background of cities

The cities Kakinada (a city in Andhra Pradesh) and Kanpur (a city in Uttar Pradesh) represent a range of SC implementation activities happening in a small port city of 57.36 sq. km to a

large 266.74 sq. km city, respectively. Kakinada (with a population of 292,923) was ranked 13th in round 1 of the SCM, while Kanpur (with a population of 2,767,031 (2011 Census)) was ranked 13th in round 2 (Ministry of Urban Development, 2015; Smart Cities Mission, 2015). Since the results of round 1 (January, 2015) and round 2 (July, 2017) were announced at different periods, the implementation state of SC projects varies for the two cities. Further, Kakinada and Kanpur belong to Tier III and Tier II categories of cities in India, respectively. Cities in India are classified based on HRA (House Rent Allowance) into Tier-I, Tier-II, and Tier-III, respectively. The existing qualifying threshold of population for HRA classification is 5,000,000 and above for Tier-I, 500,000-5,000,000 for Tier-II, and below 500,000 for Tier-III class cities (Press Trust of India, 2015). The selection of the two cities was based on the lead author's familiarity with these two cities, which provided better access to interviewees.

3.4.1.2. Description of Interviewees

Since this study looks at SCM implementation at the city level, the interviewees selected were directly engaged in either planning, proposing, approving, and/or executing SC projects in Kanpur and Kakinada. In the case of India's SCM, city-level mission implementation involves Special Purpose Vehicles (SPV) and Project Management Consultancies (PMC) selected by the respective SPVs. SPVs are limited company entities that plan, propose, and approve SC projects. The PMCs are then responsible for executing these projects. There are various PMCs involved in project execution. For example, in Kanpur, Tech Mahindra is the PMC for building the Command and Control Center (CCC), so the SPV provides the specification for the CCC in the Request for Proposal for the CCC, but Tech Mahindra is the PMC that implements the CCC in collaboration with contractors who are recruited by Tech Mahindra. The interviewees, government officials, and industry professionals were identified and contacted using information available on the SCM and city websites, and social platforms

such as LinkedIn, Twitter, ResearchGate, etc. The government officials contacted include members from Special Purpose Vehicles (SPVs) and local municipalities at the city level who were responsible for implementing projects under the SCM. The contact information of these officials was obtained from the city municipality's website. Industry professionals were identified through LinkedIn, referrals from the respondents and other known contacts from the lead author's internship experience at the National Institute of Urban Affairs, India, and by the publications/reports showcased on ResearchGate (https://www.researchgate.net/), a public forum where researchers share their reports, papers, and data.

Twenty experts were interviewed: 13 government officers (seven in Kakinada and six in Kanpur) and 7 industrial professionals/consultants. Table 3 provides further information about the interviewee sample. An open interview technique with probing questions was used. The interview questions addressed the type of SC projects being implemented, the current situation of SC projects, various challenges faced by the respondent's organization, and the antecedents and consequences of these challenges. Interview memos were written during interviews and detailed notes were prepared after each interview. Rather than asking the interviewees to rank potential challenges, the order in which challenges were mentioned were treated as the sequence of the importance of these challenges.

Table 3: Description of interviewee sample.

	Industrial Professionals	**Government Officials, Kakinada**	**Government Officials, Kanpur**
Total Interviewees	7	7	6
Age	30-45	30-50	28-50
Gender	All males	One female and six males	Two females and four males
Education	Having a Bachelor's degree and above (one Ph.D.)	Graduation and above	Graduation and above

Work Experience	Ranging from 5 years to more than 15 years	Ranging from 2 years to more than 10 years	Ranging from 6 months to 10 years
Interview Duration	35-55 minutes	20-55 minutes	15-45 minutes

3.4.2. Method

In this study we used two qualitative methods to develop a model of risks in implementing SC projects at the city level. We applied Braun and Clarke (2006) thematic analysis framework to identify a set of risks from the interview data. After the seven risk categories were identified, risk frequencies for the sample and sample sub-types, which included industrial professionals and government officials, was also calculated to identify the prevalence of risk perception among the two types of interviewees. We then used revealed causal mapping analysis (Nelson, Nadkarni, Narayanan, & Ghods, 2000) to develop a model of risks and their linkages.

3.4.2.1. Thematic Mapping

Thematic analysis is the process of identifying patterns or themes within qualitative data. Braun and Clarke (2006) suggest that it is the first qualitative method that should be learned as "it provides core skills that will be useful for conducting many other kinds of analysis" (p.78). The goal of thematic analysis is to identify themes (patterns in the data) that are important or interesting, and use these themes to address the research or discuss/describe an issue (Maguire & Delahunt, 2017). The methodology is much more than simply summarizing the data; a good thematic analysis interprets and makes sense of it (Braun & Clarke, 2006; Clarke & Braun, 2013). It is an iterative process to cluster ideas/patterns seen in the data, which in this case were interviews, into themes (referred as risks in this study) and sub-themes (referred as risk sub-components in this study) and cross-comparing them with

identified themes, collapsing redundant themes, and discovering new themes. The data analysis can be seen in Table 11 in Annexure 2.

3.4.2.2. Causal Mapping

We used causal mapping analysis to identify causal relationships among the risks in the interview data. A revealed causal map is "the network of causal relations embedded in an individual's explicit statements" (Nelson et al., 2000). We followed the rigorous causal mapping analysis procedure outlined in Nelson et al. (2000). First, we identified causal statements in the interview transcripts. Second, we constructed raw causal maps for the twenty respondents using causes and effects from the causal statements identified in the previous step. Third, we use the risk classification from our thematic analysis to develop the risk-level and risk sub-component-level revealed causal maps. Fourth, we developed an aggregated causal map by combining revealed causal maps of all respondents and identifying risk co-occurrences (shown in Table 12 in Annexure 2). Adjacency and reachability matrices were calculated to capture direct and indirect causal linkages. Fifth, we used the results from the reachability matrix to identify the strength of causal relationships in the aggregated construct level map. We referred to Fahey and Narayanan (1989), Nelson et al. (2000), and Riemenschneider, Armstrong, Allen, and Reid (2006) for detailed procedures and examples of studies that used causal mapping methods. We computed adjacency and reachability matrices based on twenty interview responses. The reachability matrix was computed using Equation 1:

$$R = A + A^2 + A^3 + A^4 + A^5 + A^6 \quad (1)$$

where R is a reachability matrix and A is the initial reachability matrix which is the adjacency matrix.

The values in the adjacency matrix (shown in Table 4) reflect the percentage of total linkages between the risk types (Ford & Hegarty, 1984). In contrast, the reachability matrix (shown in Table 5) considers the cumulative direct and indirect effects of a risk type on all other risk types. As suggested by Riemenschneider et al. (2006), we retained only those reachability values that were 0.04 or above in our causal model. A higher reachability value indicates that there are more direct and indirect paths between two constructs, suggesting a stronger cause-effect relationship.

We took several steps to ensure trustworthiness of this study by: 1) developing rich details of risk categories so that others can validate our findings to other settings, and 2) ensuring the data coding, themes generated, and causal mapping analysis were performed by a single author. However, using a random selection of statements, the codes generated were examined by another researcher who was not involved in the coding and analysis procedure. Any disagreements in coding were resolved through discussion. Since this research is qualitative in nature and assumes that each researcher has a unique interpretation of findings, the concept of inter-rater reliability that has been widely used in quantitative research, is not appropriate for this research (Lincoln & Guba, 1985).

3.5. Results

We first discuss the results of the risk classification from the thematic analysis, followed by the frequency analysis of their occurrences. We then discuss the risk model and their linkages from revealed causal mapping analysis.

3.5.1. Classification of risks

We found seven types of risks in implementing SC projects that include Resource Management and Partnership, Institutional, Scheduling and Execution, Social, Political,

Technology, and Financial (Figure 8). This section describes these seven risks, identifying the sub-components of each risk type.

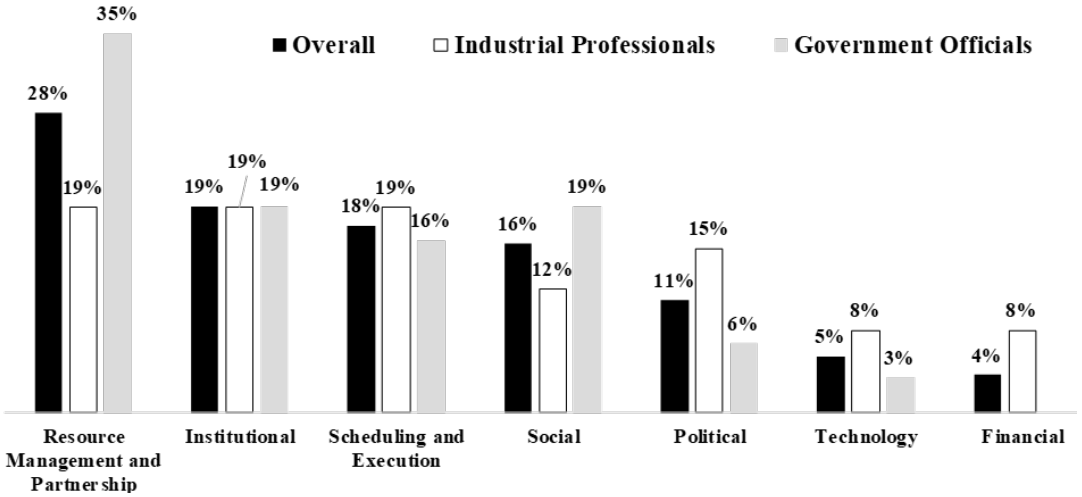


Figure 8: Frequency of occurrence of risk categories in the interviews

(1) **Resource management and partnership risks** are the risks that are related to the presence of multiple stakeholders, partnerships, asset ownerships, human resources, marketing, and network performance (Techatassanasoontorn & Suo, 2010). These risks are most often mentioned by government officials as shown in Figure 8. The government officials suggested that "land acquisition" is one of the biggest hurdles delaying project implementation. For instance, Kanpur government officials mentioned that the establishment of a Sewage Treatment Plant has been put on hold for a long time because of the land acquisition negotiations. Further, government officials indicated "hesitation of local contractors to bid" for the project due to a "lack of expertise and capacity". The lack of local contractor expertise is also reflected by "very few bidders" responding to the Request for Proposals (RFP) for SC projects as described by government officials. Kanpur government officials mentioned that several RFPs have been posted on their website and their deadlines have been

extended, yet there has not been any response to some of the RFPs. Further, some government officials mentioned that the limited number of local contractors that bid for these contracts (in the past) have resulted in the "questionable quality" of final deliverables. Kakinada officials recognized poor air-connectivity to bigger cities as a barrier preventing private consultants coming to their city. Another concern highlighted by the government officials in both Kakinada and Kanpur, is that big players who are well versed with the concept of smart cities are not interested in investing in smaller cities due to the low cost of the projects. For instance, Kakinada government officials mentioned that RFPs for projects that had high costs (more than 10 crores INR – i.e., 1.4 million USD – such as a Smart Road) received a better response than projects with lower cost (less than a crore INR – i.e., 140,000 USD). On the contrary, industry professionals indicated that working with city officials had not been a good experience and used phrases such as "difficult" and they "do not trust the city officials" when it comes to "timely payments", leading to a lower participation of private partners. Lastly, industry professionals suggested that SC projects planned under SCM involve "a range of stakeholders" and bringing all of them to consensus takes time.

(2) **Institutional risks** are described as the risks that arise due to the working style and nature of implementing institutions/agencies at the city level, which in this case are the Special Purpose Vehicles (SPVs) and city municipalities. Institutional risks, the second most mentioned risks by the interviewers have a complex network of sub-components as indicated by thematic mapping (shown in Figure 9).

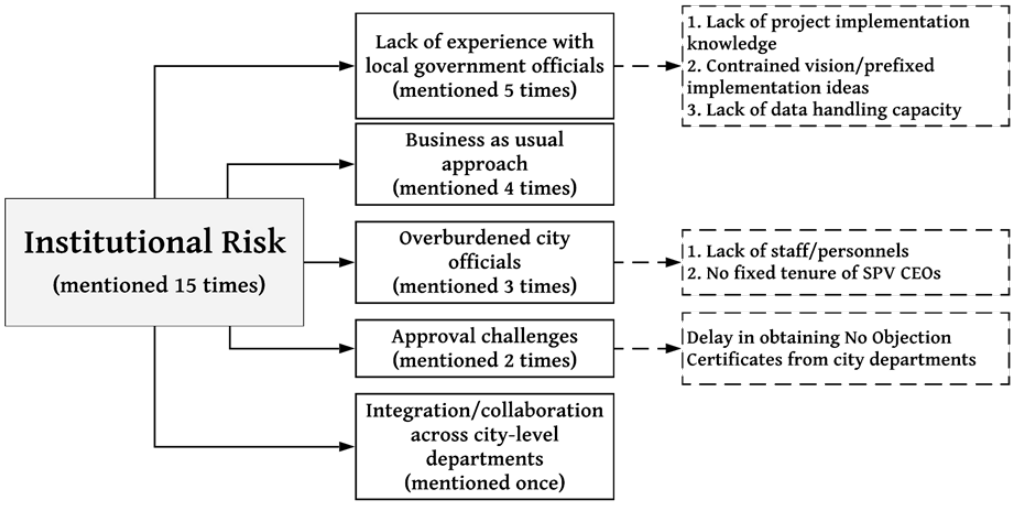


Figure 9: Sub-components of Institutional risks.

Both government officials and industry professionals mentioned that a “lack of experience and capacity” of government officials was one of the major risks in successfully implementing a project. Industry professionals indicated that the SC concept is new for city officials and the proper implementation of SC projects requires a “broader vision” and “an open mind for trying out projects” that have not been implemented in the past. However, industry professionals highlighted that a “lack of project implementation knowledge”, a “constrained vision”, “prefixed ideas about the implementation strategy”, and a “lack of capacity to manage data gathered” from launching SC projects remain some of the major challenges faced by city officials. In addition to following the “business as usual” approach of the city agencies was a major hindrance to speeding up the implementation process. However, some government officials mentioned that the implementation of several national missions such as SCM, in addition to executing day-to-day functioning of municipalities, had “overburdened city officials”. Moreover, project implementation has been hampered by the SPV’s Chief Executive Officer (CEO) position having “no fix tenure and being

prone to frequent transfers". Furthermore, multiple departments at the city level (having overlapping functions) have made collaboration across these agencies difficult, further delaying the approval process for various project activities.

Several reports have highlighted a lack of synergy between the SPVs and municipal bodies, which has resulted in poor project delivery under the SCM. However, one of the government officials in Kakinada mentioned that SPVs and municipal bodies are seen cooperating with one another. The official further mentioned that since "the CEO of the SPV" is the city's "Municipal Commissioner", therefore, there has to be synergies between SPV and local urban bodies.

On preliminary analysis, it was found that Institutional risks sub-components (shown in Figure 9) might also have some causal linkages. For instance, a lack of experience among city government officials, a lack of integration/collaboration across city level agencies, and their "business as usual" approach resulted in delays in granting required approvals. However, city officials have responsibilities related to the day-to-day functioning of the city that result in the overburdening of officials due to a lack of staff/personnel to carry out the required duties.

(3) **Scheduling and Execution risks** emerged as the third most mentioned risk by industry professionals and government officials and can be described as the risk that deals with challenges due to a "lack of strict enforcement of policies" in the city. These risks are a result of weak regulatory institutions as argued by (Bruton, Dess, & Janney, 2007). For instance, news reports confirmed that traffic police's lack of ability to stop vehicle users from violating traffic rules failed to successfully implement Intelligent Traffic Management System (ITMS) in two major junctions in Kanpur. Furthermore, some industrial professionals and government officials admitted that

"haste in delivering the projects without proper planning" may result in unsuccessful projects. For instance, Kanpur city officials implemented e-challans (ticket) for citizens violating traffic rules at two junctions without considering that not all citizens have internet connectivity. This was later revised to sending challans by mail which further faced execution challenges as the fee for the mail was charged from the citizens who violated traffic regulations. In addition, industry professionals indicated that "improper planning" leads to a "lack of integration between on-going and proposed projects" and highlighted that in most cases, the proposed "project timeline was not realistic" as most of the project schedule was consumed by "data gathering".

(4) **Social risks** can be described as the risks that arise because of a lack of knowledge among citizens about the SC concept. Both government officials and industrial professionals mentioned that proper execution of SC projects is only possible if "citizens participate" by "abiding by enforcement policies" framed to enable the smooth implementation of projects. For instance, the Naveen market in Kanpur was proposed as a car free zone and citizens were requested to not use vehicles in the area. However, citizens were unhappy and tried breaking the barricading saying this causes inconvenience. Further, a government official mentioned that only providing suggestions in "how to make a city better may not be the solution" and "educating fellow citizens about the projects being executed" in the city may be equally important. Some government officials mentioned that the "impatience of citizens" toward project delivery has been a major problem. For instance, temporary road closures for laying underground wiring/cables in Kakinada took more than the expected time as citizens continued using the closed roads which affected the work. Further, government officials argued that a smart city cannot be formed without

"smart and responsible citizens" who are aware of their duties and not just their rights. However, none of the interviews discussed the issue of digital divide which is more commonly seen in the cities of emerging economies and has been reported in developed nations (Zanella et al., 2014) as well.

(5) **Political risks** did not receive much emphasis among government officials, but these officials seemed somewhat dissatisfied by the role of the State government, but preferred not to comment further. Although, one of the government officials mentioned,

> "the cities needed smart politicians who recognize what value a project may have for the people, [rather than] just adding a technology component [to a project]."

On the contrary, industrial professionals considered political risk as a major drawback resulting in the haphazard implementation of SC projects. Industry professionals highlighted that a "lack of political will" and "passive state governments" resulted in slower execution of the projects. One of the industry professionals indicated that local politicians have at times tried to tell them "what needs to be done" and "suggested changes" in proposed projects prepared by teams of industry professionals. However, the local politicians "did not put pressure" on them to include the changes they suggested. Interestingly, one common expression shared among most interviewees included praises for the Central government and the Prime Minister for their efforts towards holistic urban development.

(6) **Technology risks** are the risks associated with the availability of technology infrastructure, technology selection, and its implementation (Gupta et al.). On the one hand, government officials indicated a "lack of technical know-how" among the contractors as a major technology risk. On the other hand, industry professionals have

concerns over a “lack of a policy framework” on using technology-enabled platforms to capture citizen data on traffic and other utility usage such as water, power, etc. and managing the data collected through these platforms.

(7) **Financial risks** relate to major funding problems that may hamper the project existence and its success. One of the main sub-themes that emerged in the interviews included “delays in payments” to contractors, which was mentioned by industry professionals. This risk sub-component is important as it affects the participation of private partners in the execution of SC projects. Two other phrases that were frequently mentioned by the industry professionals were “budget constraints” and “designing financially infeasible projects”. Interestingly, government officials did not once mention financial risks (as shown in Figure 8), which indicate that the SPV, the entity responsible for disbursing the funds, lacks the capacity to perform its duties. Therefore, the challenge facing SPVs is more about disposing and managing funds than obtaining funds. As SC projects are significant in terms of their size and budget, poor financial planning may result in delays to project completion due to a lack of available finance at critical stages of a project.

shows the overall occurrences of the seven risk categories indicating the importance of the various risks prevalent in implementing SC projects in Kakinada and Kanpur. The frequency of occurrences of risk types was slightly different for industry professionals and government officials. While both industry professionals and city officials mentioned Institutional risks with equal importance, the Resource Management and Partnership risks and Social risks were seen to be more concerning for the government officials than for industry professionals. On the contrary, city officials rarely mention Technology and Financial risks that were considered as being crucial by industry professionals. Both the groups highlight Political risks

and Scheduling and Execution risks. However, industry professionals mentioned both of these risks more frequently than city government officials.

Both Kakinada and Kanpur do not belong to the group of metropolitan cities of India that have better access to funds, resources, and technology partners. Yet the cities discussed different risk priorities. For instance, Kakinada officials have more concerns about Scheduling and Execution risks, while Kanpur officials more frequently mentioned Resource Management and Partnership risks. This difference is due to the different stages of SC implementation of the cities.

3.5.2. Model of SC risks and their linkages

Using the risk classification described earlier, aggregated revealed causal map, and adjacency and reachability matrices (shown in Table 4 and Table 5).

Table 4: Aggregated Adjacency Matrix.

Source/Target	Financial	Institutional	Political	Resource and Partnership	Scheduling and Execution	Social	Technology
Financial	-	-	-	0.15	-	-	-
Institutional	0.05	-	-	0.05	0.05	-	0.05
Political	-	-	-	-	0.1	-	-
Resource and Partnership	-	-	-	0.1	0.1	-	-
Scheduling and Execution	-	-	-	-	-	0.1	-
Social	-	-	-	0.05	0.05	-	-
Technology	-	-	-	0.15	-	-	-

Table 5: Aggregated Reachability Matrix.

Source/Target	Financial	Institutional	Political	Resource and Partnership	Scheduling and Execution	Social	Technology
Financial	-	-	-	**0.17**	0.02	-	-
Institutional	**0.05**	-	-	**0.07**	**0.06**	0.01	**0.05**
Political	-	-	-	-	**0.10**	0.01	-
Resource and Partnership	-	-	-	**0.11**	**0.11**	0.01	-
Scheduling and Execution	-	-	-	0.01	0.01	**0.10**	-

Source/Target	Financial	Institutional	Political	Resource and Partnership	Scheduling and Execution	Social	Technology
Social	-	-	-	**0.06**	**0.06**	0.01	-
Technology	-	-	-	**0.17**	0.02	-	-

Note: *Bold numeric values in the table indicate significant values (i.e., greater than .04)*

It is now possible to explore the causal relationships among the seven risk categories (shown in Figure 10) using aggregated (Table 4) and reachability matrices (Table 5).

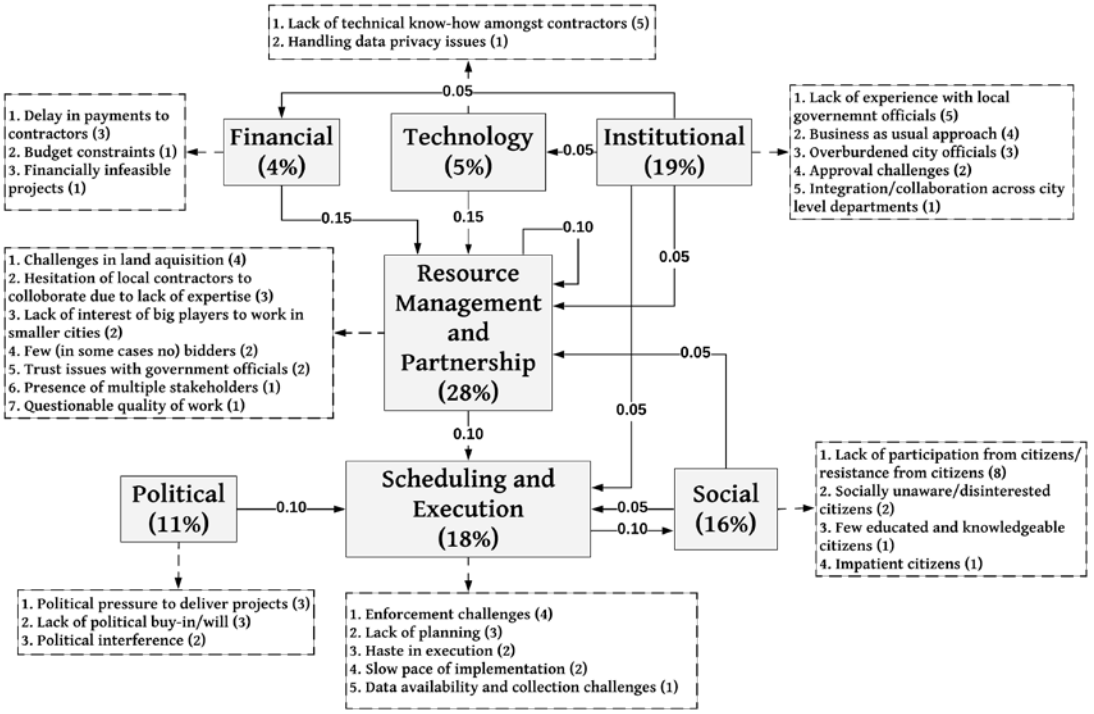


Figure 10: Aggregated Revealed Causal Map of SC risks.

Note: The grey boxes indicate the major risks found in implementing smart city projects in Indian cities. The % mentioned in the box indicates the frequency of their occurrence in the interviews, the value on the arrow indicates the connection between the risks (i.e., the higher the value, the greater the number of direct causal linkages between the risks), and the dashed boxes indicate the sub-components of the major risks identified in this study with the frequency of the number of times they were mentioned in brackets.

Resource Management and Partnership risks: The analysis reveals that Resource Management and Partnership risks were found to be significantly influenced by most risk

categories. However, they affect only Scheduling and Execution risks. An industrial professional mentioned that the slower pace of execution is a consequence of the "multiple stakeholders involved" in project planning and delivery and the "challenge of bringing them to consensus". Further, government officials reiterated the "difficulty in land acquisition" as a major risk sub-component causing "delays in project delivery". Moreover, resource management and partnership risks are the only risks that were self-influencing. For instance, a city official mentioned a "lack of expertise among local contractors [on SCs and their implementation] makes them not bid for the projects." Another city official highlighted that "distrust among private players towards city agencies" is another concern that results in very few private partners.

Institutional Risks: Institutional risks significantly affect Financial, Resource Management and Partnership, Scheduling and Execution, and Technology risks. However, they are not influenced by any other risk categories (shown in Figure 10). Industrial professionals stressed the influence of Institutional risks on Resource Management and Partnership risks. One industrial professional stated that:

> "Even though SPVs have been created, [the employees of these SPVs are] still the same people [who have been working in a municipality and have their] old style of working, business as usual approach in dealing with approvals, and constrained vision towards implementing projects, [which makes it difficult for private partners to work with the government officials]."

Another industrial professional discussed the complex policies relating to land acquisition, which delays acquiring land for a project. Similar findings were suggested by previous studies that the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation, and Resettlement (LARR) Act implemented in 2013 (Mishra, 2013) has made the process of land acquisition lengthy and complex (Hoelscher, 2016).

Moreover, one of the industrial professionals mentioned that a delay in the approval process may result in a delay in payments to the contractors, highlighting the impact of institutional risks on financial risks. Another industry professional discussed the impact of institutional risks on technology risks due to limited technical expertise and having no policy on data privacy in place, resulting in a failure to implement a project with a major technology component.

Finally, two government officials indicated that institutional risks could result in scheduling and execution delays. For example, the frequent transfers of CEOs means their replacements need time to become accustomed to their new settings and see the value of the proposed SC projects. To address this problem, they recommended a fix-term (5 years) for CEOs.

Scheduling and Execution risks: Scheduling and execution risks are the second most impacted risks after resource management and partnership risks. Findings from the causal mapping indicate that Scheduling and Execution risks only impact Social risks, and is the consequence of a "lack of strict enforcement of policies" leading to citizens breaking laws such as not following traffic rules, etc.

Social risks: Social risks impact Scheduling and Execution risks, both directly and indirectly. One of the government officials mentioned that citizens are excited by SC initiatives, but sometimes this excitement may lead to their impatience and raise expectations relating to the rapid implementation of a project – e.g., they complain about roadblocks and inconvenience caused due to project implementation. Further, their non-cooperation by not following the temporary traffic enforcement rules causes obstruction in implementing projects. Further, government officials considered the informality issues as a Social risk, which influences

Resource Management and Partnership risks. In support of this argument, one government official stated:

> "Land acquisition [is one of the first tasks in implementing most projects, which] becomes tedious due to resistance from [citizens who are either the] land owners or have encroached onto public land." Further, "agreeing on suitable compensation [with land owners was reported as] time consuming, [… given their] limited knowledge [about the] benefits [of the SC initiatives]."

However, previous studies by Baka (2013), Narain (2009), and Doshi (2015) have recognized the displacement of informal settlers in the process of acquiring land for faster implementation of large-scale projects.

Political risks: Political risks have an impact on Scheduling and Execution risks and are not impacted by any other risk. One industry professional mentioned the role of local political leaders in leading the decision-making process and sometimes suggesting changes during the execution phase that causes last minute amendments and further delays.

Technology risks: The adjacency matrix (Table 4) shows a direct causal linkage between Technology risks and Resource Management and Partnership risks. One government official agreed with the above statement, stating that:

> "A lack of professional knowledge and adequate technical skills [among the local contractors] result in fewer (or no) choices [in awarding the project, further resulting in the] questionable quality of deliverables."

Financial risks: The adjacency matrix (Table 4) shows a direct causal linkage between Financial risks and Resource Management and Partnership risks and was supported by one industrial professional, mentioning that:

> "Not being paid the full payment or having to run several times for payment [after the work is completed by the private contractors] discourages [private agencies and contractors] to work with municipalities."

3.6. Discussion

This study investigates the risk landscape in SC project implementation in a developing nation context. It contributes to the literature in several ways. First, this study extends the risk literature in a new domain of SC projects, which until now were mostly explored on traditional infrastructure and/or IT projects. Second, the study identifies risk sub-components and reveals the complex relationship between risks associated with implementing SCM activities, as described by industry professionals and government officials. Additionally, this research also explores the complex network of sub-components of Institutional risks, which in previous studies were identified as local government challenges (Kandpal, Kaur, & Tyagi, 2017) and have mostly focused on overlapping functions of multiple agencies. Third, the frequency analysis indicates that Technology and Financial risks, which are often cited in studies and industry reports (Hoelscher, 2016; Naphade, Banavar, Harrison, Paraszczak, & Morris, 2011) as major challenges in the successful implementation of SC projects, especially in a developed nation, were the least mentioned by the interviewees. The lower frequency of occurrences of these risks does not indicate a greater financial and technical capacity in Indian cities (representing a developing nation). Instead, it highlights that Resource Management and Partnership risks and Institutional risks are more crucial to the successful implementation of SC projects. Additionally, both risks have a significant impact on other risk categories as revealed by the adjacency and reachability matrices, capturing the direct and indirect causal linkages. Lastly, the prevalence of risks such as Institutional, Scheduling and Execution, and Partnership and Social risks and their causal linkages reinforces the

findings of Kummitha and Crutzen (2019) that the role of city governments in emerging economies is not only to build a regulatory environment, but to also focus on creating a positive environment for the key stakeholders in the governance ecosystem.

Tier II and III cities may lack availability of resources and technology partners in comparison to Tier I cities, but industry experts recognize these cities as emerging markets to leverage opportunities (Sahasranaman, 2012; Sankhe, Vittal, Dobbs, Mohan, & Gulati, 2010). Unlike metropolitan cities, Tier II and III cities have a smaller population to cater to and cheaper resources available for further development. However, these cities are grappling with various risks as described in this study, particularly, Institutional risks that stand out as one of the major risks influencing other risks such as Resource Management and Partnership risks present in implementing projects in both Kakinada and Kanpur. This finding further indicates that SC projects are heavily dependent on the nature of the SPVs and municipalities present in the two cities, which reinforces the observations made by Kummitha and Crutzen (2019) on the significant role of institutional environment in successfully planning smart cities. The findings of this study suggest that city municipalities and SPVs need to re-evaluate their working style and make provisions to encourage industries to come to their cities for SC development projects.

3.7. Conclusion

The Indian SCM hopes to revolutionize the way cities are planned to improve the quality of life of citizens using innovative solutions. Under the SCM, the mission activities are not focused on building new Greenfield smart cities, but on redeveloping and/or retrofitting the existing ones. Making the SC ambition into a reality comes with a long list of challenges, ranging from a lack of participation from private partners and citizens to a lack of relevant

policies to support the needed developments. This study conducts a detailed exploration of the risk landscape in two Indian cities, Kakinada and Kanpur, and identifies the risks prevalent in implementing SC projects. The study considers the perspective of experts closely associated with the mission activities at the city level, and contributes to the SC project implementation literature by describing the causal linkages between risk categories. This research provides a framework to city municipalities, city managers, and SC initiative implementers to examine the risk landscape for successfully implementing SC initiatives.

This study classified SC implementation risks into seven categories, namely, Resource Management and Partnership risks, Scheduling and Execution risks, Institutional risks, Social risks, Political risks, Technology risks, and Financial risks. The research indicates that risk priority varies for industry professionals and city government officials and risk priorities vary from city to city. Further, risk causal linkages indicated the strong influence of institutional risks that are mostly related to municipality, SPV, and existing policies on other risks such as Resource Management and Partnership risks, Scheduling and Execution risks, Social risks, Technology risks, and Financial risks. These intertwined risks may affect the successful implementation of SC projects in Indian cities. These findings suggest that risk causal linkages need to be considered to prioritize risks when proactively strategizing risk mitigation measures.

This research has succeeded in exploring the risk landscape and indicating the major risks prevalent in the cities of Kakinada and Kanpur, in addition to highlighting major causal risk linkages hindering SC implementation. However, more comprehensive and comparative insights might have been developed if additional cities that are currently regarded as more successful cases in implementing SC projects, such as Bhubaneswar, Bhopal, and Jaipur,

were included. In addition, this study incorporated the perspective of government officials and industry professional, but did not include the views of academics on current SC project implementation in India. Furthermore, the study findings suggest a need to closely examine the structure of SPVs and explore the kind of interactions taking place within the SPVs. These limitations could provide fertile ground for future research.

Chapter 4: WHAT, WHY, AND HOW OF SMART CITIES: EXPERIENCES FROM KAKINADA AND KANPUR

Abstract

Rapid urbanization in cities has critical consequences such as overcrowding, congestion, and a lack of urban services that result in increasing demand for investment in modern technologies. Globally, communities are approaching the concept of smart city (SC) by employing technology in response to the urban challenges presented by rapid urbanization. Although rapid urbanization is a problem for both developed and developing nations, the criticality of consequences is severe in the case of developing nations. While previous studies have focused on SC that were built from the ground up, there is a critical need for studies that focus on how to advance SC initiatives in developing regions faced with limited land and other resources. This study identified two proposed SCs in India - Kakinada and Kanpur - which are currently implementing SC projects to explore their SC transformation. This case study aims to explore how 'smartness' is understood in these cities and examines the local conditions shaping SC objectives by studying the existing issues in the cities, the proposed projects, and the perception of SC experts on a) What do they understand by 'smartness', b) Why cities want to become smart? and c) How will they become smart? The study findings indicate that although the high-level goals of proposed SCs in India are similar to the existing SCs, the underlying objectives and strategies vary and are shaped by urbanization challenges faced by the cities. This research also emphasizes on the key questions a SC community planning effort should address, especially in a developing nation context.

Keywords: Smart Cities, Smart Cities Mission, Rapid Urbanization, Inclusivity, Public Convenience

4.1. Introduction

The idea of the 'smart city' (SC) has become popular in the last decade with experts' world-wide highlighting that SCs present promising solutions to existing urban issues caused by rapid urbanization. For instance, SC strategies can assist in reducing emissions, increasing energy efficiency, and improving the over-all quality of life for the citizens (Ahvenniemi, Huovila, Pinto-Seppä, & Airaksinen, 2017). Both developed and developing nations are welcoming the concept by initiating and investing significant capital in SC programs and India is one of them. Based on the projections by the United Nations (2016), India will have the largest concentration of mega cities in 2030. In an effort to manage these urbanization challenges, the governing authorities have taken up initiatives such as the Mega City (1995) and Jawaharlal Nehru National Urban Renewal Mission (JNNURM) (2005). These programs have mainly focused on providing basic infrastructure services and utilities to cities without paying much attention to advancing sustainability. Recently, the Ministry of Housing and Urban Affairs (previously known as Ministry of Urban Development (MoUD) initiated the Smart Cities Mission (SCM) with a purpose of promoting economic growth and improving quality of life through the design of the Smart Cities Challenge in 2015 (Aijaz & Hoelscher, 2015). To take part in this challenge, cities competed for central government funding to implement SC strategies by submitting their Smart City Proposal (SCP) to the Government of India (GoI). Through this mission, the GoI used a competitive framework for the first time to advance a major urban development mission via three components (Ministry of Urban Development, 2015): (a) area-based developments that will transform existing areas, including slums, into better-planned ones, by retrofitting and redevelopment thereby improving livability of the whole city; (b) pan-city developments that envisaged the application of selected smart solutions to existing city-wide infrastructure; and (c) greenfield

development. Further, proposed SCs can also utilize a combination of the three strategies to become smart. SCM marks a shift in India's urban development policy as it is presents a possibility to tackle current issues of cities than solely concentrating upon Greenfield development like other developing nations such as United Arab Emirates (Masdar) (Ojo et al., 2014), South Korea (Songdo) (Kim, 2016) and China (Hangzhou) (Joss & Molella, 2013) which focused on developing SCs from scratch.

Four years from the formulation of SCM, 100 cities have been selected to implement their proposed smart activities through various rounds of the mission. In most proposed smart cities, several projects have been completed and many more are in the pipeline. The SCM provides a good opportunity for researchers to uncover the SC evolution process by closely studying cities currently in the process of implementing SC projects. Moreover, future urban development will be faced by growing land constraints and limited available resources, especially in developing and under-developed nations, so understanding how cities in these regions are approaching SC development will be increasingly important. Studying the SC development in Kakinada and Kanpur in India holds the potential to provide insights for researchers, communities, and organizations that are involved with planning similar missions/developments. Through this research, we explore a) how the cities and SC experts interpret 'smartness', b) Why the cities want to become smart? and c) How can the cities become smart?

4.2. Review of Smart City Definitions and Practices

In the last two decades, the term 'smart city' (SC) has been widely discussed and debated in the policy and planning circles across the globe. There are several schools of thought on defining a SC and these are not limited to academic scholars but include businesses such as

CISCO, IBM, and government institutions such as city municipalities and urban centres. For instance, a community development SC definition states, “A smart city will be a city whose community has learned to learn, adapt and innovate within the emerging technological age” (Coe, Paquet, & Roy, 2001). A more popular academic definition provided by Giffinger et al. (2007) describes SCs as “Well-performing modern cities built on the smart combination of endowments and activities of self-decisive, independent and aware citizens looking to develop intelligent solutions to enhance the quality of life and services.” While an industry-led definition argued that a SC is “An instrumented, interconnected and intelligent city that uses information and communication technology (ICT) to sense, analyse, and integrate critical information on core systems in running cities” (Harrison et al., 2010). A similar approach was discussed by the Smart Cities Council (2015) that describes a SC as one “which uses ICT to enhance its liveability, workability, and sustainability”. In contrast to the above definitions that focus on the city and its attributes, the Department for Business Innovation and Skills (2013) defines a SC as “a process, or series of steps, by which cities become more “liveable” and resilient and, hence, is able to respond quicker to new challenges.” Another study defining the enablers and outcomes of a SC states, “A city is smart when investments in traditional infrastructure, social development and modern (ICT) communication infrastructure fuel sustainable growth and a high quality of life, with wise management of natural resources” (A. S. Caragliu, 2011).

The above SC definitions highlight that the term has come a long way from its inception, since SCs are no longer seen as ‘an end’ objective, but as ‘the means’ to attain a better quality of life. Several studies noted this transition such as Albino et al. (2015) and Bakıcı (2013) indicating the concept is becoming more holistic than technology centric. In the early 2000s, SC development was mostly about reforms based on technological advancement through

data, monitoring, interconnectedness, and automatic steering mechanisms leading to profit making for tech companies (Söderström, Paasche, & Klauser, 2014) and less about city development. As argued by A. Caragliu, Del Bo, and Nijkamp (2009), these early initiatives were heterogeneous, unfocused, had limited effectiveness, and impacted a limited number of people. However, in the present-day scenario, technological advancement is seen as a means to focus on suggesting ways to tackle more immediate urban issues caused by rapid urbanization such as reducing traffic congestion, providing affordable housing, efficient utility services, and health care under the supervision of human guidance. These urban issues are more severe in a developing country context due to high urban population density and poverty, increasing migration rates from rural to urban areas, budding slums, and a lack of basic infrastructure including water and wastewater services, power supply, and sanitation (Hamza, 2016).

With above mentioned issues, SC development in developing country cities not only require projects that include ICT, but projects that focus on providing basic infrastructure to citizens and ensuring that a decent quality of life can be achieved (Gupta and Hall, 2017). Gupta and Hall (2017) undertook a qualitative assessment of proposed smart city vision statements and city descriptions defined by city officials in SCPs submitted to the GoI. The study found that there are similarities and differences between Indian cities' vision statements and existing smart city definitions. The top 10 keywords that appeared most frequently in the smart city definitions included ICT, Economy, Governance, Sustainable, Quality of Life, Human and Social Capital, Infrastructure, Efficiency, Energy, and Environment. These keywords indicated the major features/characteristics considered in smart city definitions. On analysing sixty vision statements of proposed smart cities in India, the 10 most frequent characteristics were identified that include Eco-friendly, Sustainable, Inclusive, Vibrant, Economy, Tourism,

Liveable, Heritage, Quality of Life, and Safe. These keywords describe the city official's vision of a smart city and reflect the city's goals to be achieved in the next 5-10 years. It was found that the most frequently occurring keywords in the smart city definitions such as "ICT" and "Governance" were almost absent in the vision documents, whereas keywords like "Inclusive," "Vibrant," and "Safe" were found more frequently in the vision statements. Additionally, the qualitative analysis of "Smart Urban form" described by six randomly selected proposed Indian smart cities highlighted the prevalence of "ease of access" as a key outcome. The SCP for these six cities indicated that more than half of the characteristics identified did not employ ICT, but still were associated with "Smart Urban form" given their connection with creating safer and more environmentally friendly neighbourhoods.

Most SC initiatives began in more affluent regions of the globe such as Europe, the United Kingdom, the United States, and in some parts of Asia. These regions put forward their version of a smart city by implementing strategies that relied on key technologies, such as modern transport technologies, efficient and sustainable mechanisms (Benner, 2003; A. S. Caragliu, 2011), and smart governance frameworks (Shapiro, 2008; Torres et al., 2005; Yovanof & Hazapis, 2009). Consequently, SC studies have tended to highlight the objectives and frameworks of developed regions (Ojo et al., 2014), which may not align with those of developing nations that face unique challenges such as rapid and unplanned urbanization. Further, recent SC studies that focus on cities in developing nation's context (Ojo et al., 2014), present the characteristics of already established SCs built from the ground up - i.e., using a green field model of development. However, there are only few studies that discuss developing smart cities using a retrofitting or redevelopment approach (Heberle & Kackar, 2006). In addition, few studies have provided an overview of SCM, discussed risks in implementing SC projects, and reviewed SC development in India. There has also been

limited study in developed or developing nations of why the cities want to become smart and how is smartness understood by SC experts and local government/planning agencies implementing mission activities. To explore these questions, it is important to investigate cities that are in the process of becoming smart. This study attempts to fill this gap by exploring the case of two proposed SCs in India – Kakinada and Kanpur – which were selected in different rounds of the Indian SCM and are currently implementing SC projects.

4.3. Data and Methods

To understand how Indian cities are conceptualizing 'smart cities' we used in-depth case studies of two proposed SCs in India - Kakinada and Kanpur. We chose the city level given the focus of the SCM on transforming cities across India. Under SCM, the proposed SCs mostly belong to Tier II (~50%) and Tier III (~43%) cities. The cities Kakinada (Tier III) and Kanpur (Tier II) (shown in

Figure 11) represent a range of SC implementation activities using a retrofitting model in a small port city to a big city, respectively. However, both the cities do not belong to the larger metropolitan cities such as Delhi or Mumbai that have better access to SC expertise and resources such as technology.

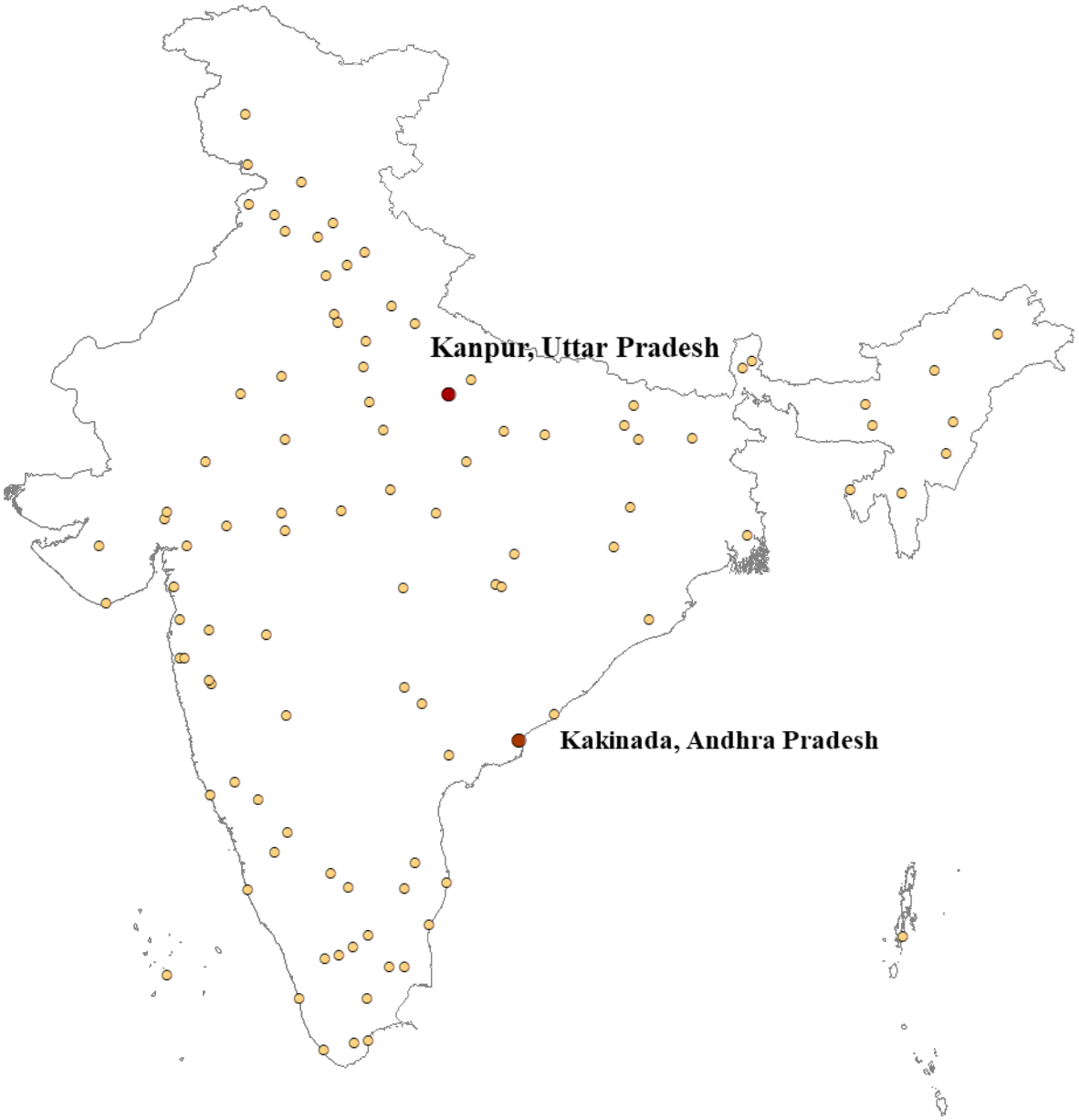


Figure 11: 100 Cities selected under SCM with red bullets indicate location of Kakinada and Kanpur.

Kakinada was ranked 13th in round 1 of the SCM, while Kanpur was ranked 13th in round 2 (Ministry of Urban Development, 2015; Smart Cities Mission, 2015). Since the results of round 1 and round 2 were announced at different periods, the implementation state of SC projects varies for the two cities. Therefore, there are more projects that have been implemented in Kakinada than Kanpur. The selection of the two cities was also based on the

lead author's familiarity with these two cities, which provided better access to interviewees. Table 6 briefly describes the two cases.

Table 6: Description of the two cities.

	Kakinada	**Kanpur**
State	Andhra Pradesh (located on the south eastern Indian coast)	Uttar Pradesh (located in north-central India)
City Area*	164 km^2	403.70 km^2
City Population*	312,538 (Tier III)	2,765,348 (Tier II)
Population Density	1906 persons per km^2	6850 persons per km^2
Population Increase* (2001-2011)	0.53%	9.92%
Literacy Rate*	80.62%	79.65%
Total Funds allocated for SCM**	1993.03 Cr	2311.97 Cr
City's self-assessment of urban features described as belonging to basic city level features (Scenario 1)**	Underground Electric Wiring Water Management Transportation and Mobility Sanitation Air Quality Wastewater Management / Water Quality Energy Efficiency Economy and Unemployment	Underground Electric Wiring Water Management Transportation and Mobility IT Connectivity Walkability Intelligent Government Services Public Open Spaces

**2011 Census, District Census*

***Smart City Proposals and Annexures of Kakinada and Kanpur*

Note 1: *Cities in India are classified based on HRA (House Rent Allowance) into Tier-I, Tier-II, and Tier-III, respectively. The existing qualifying threshold of population for HRA classification is 5,000,000 and above for Tier-I, 500,000-5,000,000 for Tier-II, and below 500,000 for Tier-III class cities (Press Trust of India, 2015).*

Note 2: *SCP's annexure provided a self-assessment of the city's urban features such as walkability, environment, citizen participation, etc. to describe its current state. The framework used four scenarios to describe the existing condition of the proposed SCs with respect to each city feature with Scenario 1 describing features present in a basic city and Scenario 4 describing features present in an advanced/smart city. For instance, a city's* ***scenario 1*** *for* ***walkability*** *will have features such as "designed mainly for the automobile", "long bus rides", "walking is difficult and often dangerous", "few pavements, existing pavements need repair and lack trees to provide shade for pedestrians",*

"lack of marked pedestrian crossings", and "traffic signals are often disobeyed". While ***scenario 4*** *will be "highly walkable", "pavements exist on every street and are maintained", "trees line many sidewalks to provide shade for pedestrians", "traffic signals control the flow of automobiles and are enforced", "a network of bike lanes exists to promote cycling", and "traffic rules are followed and enforced with great seriousness". The framework was provided in the SCM's guidelines. The feature description and the description of each scenario can be found in the annexures of each smart city proposal (at http://smartcities.gov.in/content/city_challenge.php?page=winning-city-proposals-in-round-3.php).*

We adopted the comparative case study method to perform in-depth examination of the two cities – Kakinada and Kanpur. Previous studies have used the comparative case study method to produces more generalizable knowledge about questions like how and why a particular program works or fails to work (Goodrick, 2014). The comparative case study works well in cases where the context is very important in understanding the process of implementation. This method often incorporates both qualitative and quantitative data. In this study, the comparative case study method was used to answer our research questions: *what, why* and *how* are the Indian cities transforming into smart cities? Qualitative interviews, site visits, and observations were made in the two cities. In addition, a document analysis of reports, proposals, and related annexures was performed, which included existing issues in the cities, the proposed smart city visions, and the types of projects proposed. In addition, 20 SC experts were interviewed from October 2018 to January 2019 who were closely associated with the mission activities at the city level. The interviewees consisted of government officials and industry professionals, identified and contacted using information available on the SCM and city websites and social platforms such as LinkedIn, Twitter, ResearchGate, etc. The government officials contacted include members from Special Purpose Vehicles (SPVs) and local municipalities at the city level who were responsible for implementing projects under the SCM. SPVs are limited companies led by a full time Chief Executive Officer and have

representation from Central Government, State Government, and the Urban Local Body (ULB) that can plan, approve, release funds, implement, and evaluate the SC projects at the city level (Ministry of Urban Development, 2015). The contact information of these officials was obtained from the city municipality's website. Industry professionals were identified through LinkedIn, referrals from the respondents, and other known contacts from the lead author's internship experience at the National Institute of Urban Affairs, India, and by the publications/reports showcased on ResearchGate (https://www.researchgate.net/), a public forum where researchers share their reports, papers, and data.

Table 7: Description of Interviewees.

	Industrial Professionals	**Kakinada Government Officials**	**Kanpur Government Officials**
Total Interviewees	7	7	6
Age Range	30-45	30-50	28-50
Gender	All males	Six males and One female	Four males and Two females
Educational Qualifications	Having a Bachelor's degree and above (one Ph.D.)	Graduation and above	Graduation and above
Work Experience	ranging from 5 years to more than 15 years	ranging from 2 years to more than 10 years	ranging from 6 months to 10 years
Interview Duration	35-55 minutes	20-55 minutes	15-45 minutes

A total of twenty experts were interviewed (see Table 7): 13 government officers (seven in Kakinada and six in Kanpur) and seven industrial professionals/consultants. An open interview technique with probing questions was used. The interview questions addressed the type of SC projects being implemented, the current situation of SC projects, the value that the projects may bring to the city, and the factors, which enable the project implementation. Interview memos were written during interviews and detailed notes were prepared after each

interview. Rather than asking the interviewees to rank the most important projects and their outcomes, the order in which the projects, and their outcomes were mentioned were treated as the sequence of the importance of these projects and outcomes. The outcomes that were mentioned by more than 50% of the interviewees were treated as the primary outcome and other outcomes mentioned were classified as secondary outcomes (this structure is described in Figure 12 in Result's section).

Local exploration of the concept also allowed the assessment of how the local municipalities and other professionals, closely associated with the mission, have interpreted and translated the national mission strategies locally. Our approach in this study begins with the assumption that local actors such as municipalities and other government officials have a greater role in planning and implementing SC strategies. Although, local exploration does not mean that these proposed SCs are studied in isolation, instead, it was found that the national level mission strategies largely shaped the city level implementation.

A small number of interviewees are a major limitation of this exploratory study. Since, the objective of this study included understanding the perspective of SC implementers. Therefore, rather than trying to cover a large number of people involved in implementation, this study used purposive sampling to identify who can best describe the implementation of SC project and related challenges being faced. The sample covered a diverse range of professionals involved in project delivery (top to bottom tier in project management), from decision-makers (approving project) to people planning and designing these projects (junior engineers and team lead) to people executing these projects (PMCs professionals) and people monitoring the implementation (executive engineers, etc.).

4.4. Results

This results section begins by discussing the perspective of municipalities and industry professionals on the SCM. The interpretation of the mission is important as these interpretations later translate into how these experts are planning and shaping SC development at the local level. Next, the three research questions uncover the what, why, and how of the proposed SC development in Kakinada and Kanpur by providing the interviewees' and authors' comments on the SC process.

4.4.1. Interpreting the SCM from the lens of municipalities and industry professionals

Some view the SCM as a national program that is critical for addressing growing urban challenges, but others see it as an election agenda. Most SC experts from industry who were interviewed seemed happy with the mission and described it using phrases such as "timely", "began a positive conversation between cities, academia, industrial professionals", "making citizen engagement essential", and "making cities compete with each other". While one of the industrial professionals stated that the SCM is

> "A good initiative which lacks the bigger picture." One of the SC consultants described the mission as "an initiative to generate new ideas and to compel local municipalities to think out of the box solutions [to respond to the urban issues faced by the cities] but the mission was rolled out in haste [by the GoI and was not thought through]".

This meant that the broader stages of the mission such as the selection of cities, proposal development, etc. were well documented, but intricacies of the mission such as the role of various local agencies, integration of proposed projects with the city development plan, etc. were left unquestioned. Further, the local agencies with a lack of expertise on the SC concept were made responsible to transform the existing cities into SCs.

The professionals from municipalities and SPVs were enthusiastic and welcoming to the mission and related activities and used phrases such as “holistic”, “strategic”, “not project based but idea driven”, “involving citizens in the process”, and “a step towards comprehensiveness, unlike previous missions”. In contrast, one of the government officials considered comprehensiveness of the mission as one of the biggest drawbacks of the mission and stated,

> “The biggest challenge with the mission is that there is no definition of a smart city which should have been the first thing to do in the mission.”

This leaves the officials at the city level who are responsible to implement the mission activities wondering what is ‘smart’. Another government official stated that SCM is

> “A very good concept which fails to provide a framework [to the city officials] to implement the mission”.

Moreover, few government officials praised the comprehensiveness of the mission, but at the same time worried about the pressure such missions may place on the city officials without providing them with the needed resources.

The interview findings indicated that the SCM has (1) brought a new level of energy amongst the city municipalities in forming SC strategies for their respective cities. This energy has trickled down in recruiting a new and young workforce on a contractual basis for the local implementation of SC projects and the identification of affordable and environment-friendly solutions to existing urban issues. (2) Has improved the city development programs/missions by including citizen engagement. In the first phase of the SCM, citizen participation created a process where the opinion of citizens was directly impacting city development strategies. (3) The SCM came with the ambition to develop cities more holistically, but the mission lacked a

concrete SC definition that could narrow down the vision into definite SC strategies that could be implemented by the municipalities. Most interviewees were positive about the mission outcomes. However, some of the interviewees seemed to be juggling the daily city functions and planning the SC strategies. With the SC concept being new to the municipalities, detailed strategies from the mission guidelines may streamline their course of action and help in achieving their SC goals much more efficiently.

4.4.2. What do cities understand by "smart"?

To understand what a SC might look like and what kind of urban form is being planned in the proposed SCs in India, we asked interviewees to reflect on what do they understand by the term 'smart' in the SCM. Most interviewees agreed that the SC projects proposed in Indian cities are different from the SCs that exist in North American, European, and/or Australian cities. One of the industry professionals described this difference by stating,

> "Smartness is a gradual process starting with provision of infrastructure, for instance, smart road for Indian cities is about building a road which can be accessed by one and all. This is a first step and should aim at building a strong foundation for becoming smart."

Another industry expert described the focus on SC components by mentioning,

> "It is important to focus on citizen's convenience [as smart cities are for citizens] and provide basic need infrastructure [for commuting, roads, water, electric supply, and waste management,] apart from city beautification and promoting tourism".

Thus, most projects implemented (or under implementation) are citizen focused and have fewer smart components. In contrast, the city officials used phrases such as "streamlining infrastructure development", "using data driven strategies in planning urban services" and "connecting the urban services" as describing 'smart'. Further, when clarifying their

statements, the officials mentioned that traditionally urban services planned in the city were done in silos and thus the focus of the mission activities was to develop a holistic channel to implement urban projects. However, the officials agreed that there are fewer smart elements in place and mission activities are more focused on getting the basics right. The government officials also highlighted that focus is on improving the physical infrastructure and strengthening local institutional mechanism.

Both Kakinada and Kanpur proposed a retrofitting model of development for ABD of their Central business district areas that comprised of a mix of residential, commercial, institutional, parks, and stadiums. The areas chosen for ABD have places that are recognized as containing a city's identity and culture, have most of the basic infrastructure in place, have residents in the selected area who were more receptive to the planned SC initiatives, and were willing to pay for better services and improved living. Although the government officials of Kanpur and Kakinada advanced similar types of projects and developmental model, the rationale for choosing the type of development model and area selection varied. In Kanpur, the government officials selected 1475 acres to retrofit that consisted of a Central Business District area that had a good mix of residential, commercial, public building, parks, stadiums, and a 4.3 km stretch of river bank over a green field area, since city officials wanted to develop an area that was struggling with urban issues (Kanpur Smart City, 2016). On the other hand, Kakinada government officials chose a 1375 acres to retrofit since it was difficult to find a single land parcel of 250 acres in and around Kakinada Municipal Corporation for a green field development (Kakinada Smart City, 2016). Some of the major SC projects implemented (under implementation) and their perceived benefits discussed by the city government officials are described in Figure 12.

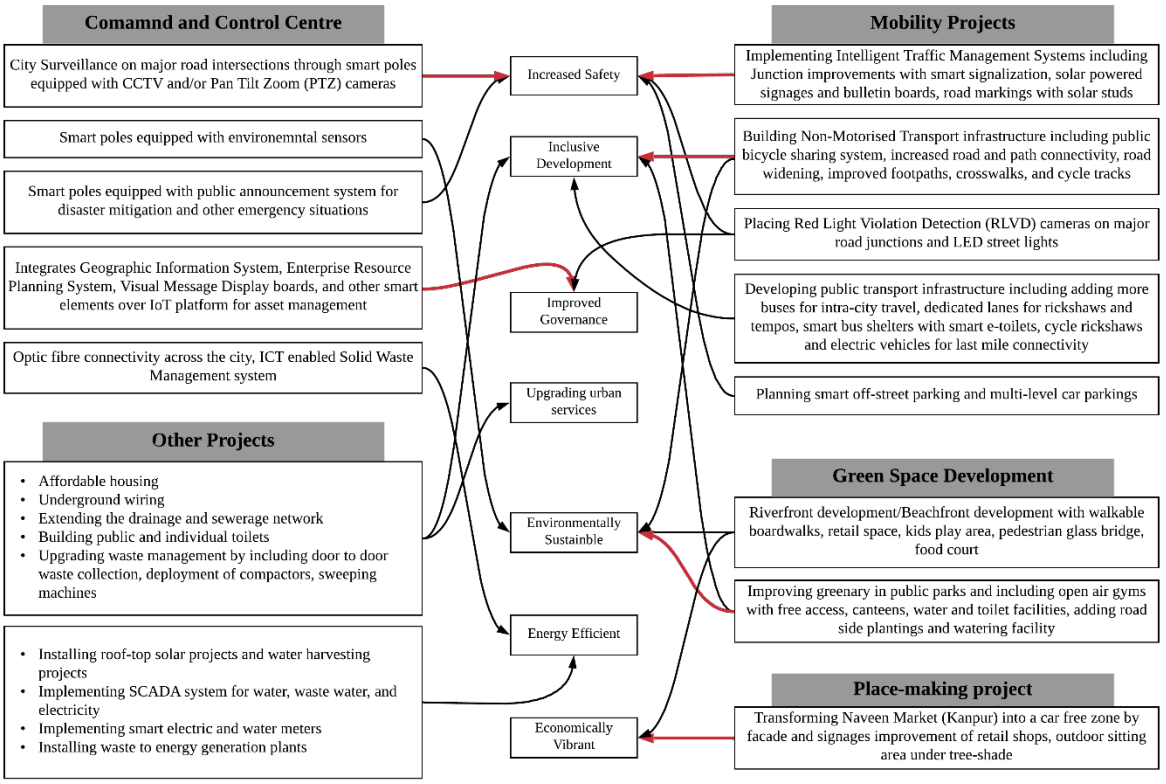


Figure 12: Smart city components and their outcome.

***Note**: Red arrows indicate the primary outcomes of the project and Black arrow indicate the secondary outcomes*

The analysis of interviews with city officials indicated that outcomes such as increased safety, environmentally sustainable, and inclusive development are more readily mentioned than the other outcomes (Figure 12). Further, the interviews indicated that similar projects may be having different outcomes. For instance, the Command and Control Centre (CCC) in Kakinada was referred to as the brain of the city system. As the CCC is responsible for city surveillance on major road intersections, the personnel in the center are provided with real-time data and information about traffic and law and order to facilitate data driven decision making. While, in Kanpur, only one or two components of the CCC were functional that included city surveillance of road intersections, resulting in improved traffic management that has reduced traffic congestion, organized city traffic, and made the streets safer. Therefore, city officials referred to the CCCs as the eyes of the city system. Additionally, the primary

outcome mentioned for mobility projects in Kakinada was universal access to roads, while in Kanpur the primary outcome mentioned was improving citizen road safety.

Urbanization in the two cities has been haphazard, resulting in a lack of urban services and increasing inequalities. While the previous missions/programs focused on these urban challenges, they were more of a knee-jerk reaction than a well-conceived strategy to improve livability for city residents. Thus, traditional city planning had not receives the emphasis it needed to support a holistic city planning and transformation effort. With the SCM's implementation focusing on holistic development, it is important to first understand how city managers understand 'smartness'. The interviews indicated that the term 'smart' is understood slightly differently by the industry professionals and city officials. It was interesting to note that the industry professionals defined 'smartness' with respect to the users (citizens, in this case) while the city officials focused on the process. For example, using data to plan cities. It is understandable that the foremost priority of the city officials of Kakinada and Kanpur was to provide basic amenities, using technological solutions wherever they were needed, which is also reflected in some of the projects mentioned above. However, the cities needed to be cautious in relying too much on CCC generated data for planning, as they faced the issue of informality, which may not necessarily be predicted by data-oriented mechanisms.

4.4.3. Why do cities want to become smart?

To understand the goal of the cities to become smart, we analyzed the visions of the proposed SCs. Kakinada's succinct vision statement is further elaborated by providing SC objectives. The city officials plan to "Transform Kakinada from Pensioners' Paradise to Economic Destination." The proposed smart city aspires to become "economically vibrant", "inclusive",

"livable", and "sustainable" based on "its existing and potential strengths" including the Port, Tourism, and the Oil and Gas sector. However, the city officials realize that economic development associated with industrialization activities is accompanied with pollution and degradation of natural resources. Therefore, to become sustainable in the long run, Kakinada plans to add more green cover and harness renewable energy to become energy efficient. Additionally, the city proposes to overcome its weaknesses by providing high quality urban infrastructure and services in a smarter way. Like Kakinada, Kanpur also focuses on its industrial strength to become smart but at the same time puts emphasis on improving the city's sustainability. Kanpur outlines its SC goal by mentioning the key five themes (or projects) the city plans to achieve through the mission activities. Kanpur aspires to "Transform into an inclusive, vibrant city of opportunities with efficient urban services, sustainable growth, and healthy living keeping Ganga, Industries, and commerce in focus." The five key projects to achieve this vision were aimed at becoming a regional growth center, embedding smart mobility, 'Citizen First' city governance, sustainability related goals in providing essential services to the citizens, and reducing air and water pollution levels in the city.

When asked, "Why is it important to become a smart city?" the city officials usually paused before answering. This question was a follow-up to "Is it important to become a smart city", to which 12 out of 13 interviewees mentioned, "Yes". These questions were specific to city officials to understand what values they seek in becoming a SC. The officials from both cities used phrases such as becoming a SC is "a step to integrate the various urban missions", "important for holistic development of a city", and "will bring in more tourists and businesses". Other phrases, which indicate the perceptions of interviewees on becoming smart, included "safer and cleaner cities" "healthier cities", "ease of access to urban services

to each and every citizen", and "city beautification". Kakinada government officials mentioned phrases such as "building transparency", "improving public convenience", and transforming into "livable cities" as their major goal by becoming a SC. One of the government officials from Kakinada expressed that the mission activities was bringing accountability to government procedures. Moreover, a government official from Kanpur stated, the "city's focus is on making streets safer for one and all under smart city mission activities". Another Kanpur government official mentioned, "A smart city needs to be greener, cleaner, and a city where people care for each other."

The visions and proposed projects reiterated the need to become economically vibrant, however, this concept was not frequently spoken about in the interviews. The current scenario of Kakinada and Kanpur in "Economy and Employment" is 1 (see Table 6) and 2 (Kanpur Smart City, 2016), respectively, describing the urgent need to uplift the cities economically. Therefore, the vision statements of both the cities emphasized economic vibrancy. Kakinada indicated the need to attract more investment in real estate, tourism, and transportation in addition to reviving a boat building yard to improve the local economy. While Kanpur plans to use its strategic location and proposed metro-development and airport to bridge the connectivity with other regions, which would bring new business opportunities and strengthen the old ones. Further, the emphasis on economic development is also indicated by the cities' SCPs, which state that while both the cities have a strong educational base with well-known technical, medical, and other research institutes, a large section of the workforce is unable to participate in industrial development due to a lack of skills and increasing out-migration. While, livability, inclusion, and sustainability were emphasized more than economic vibrancy in the city official interviews, the officials did recognize that better connectivity, improved livability conditions, and a cleaner environment will attract more

businesses and tourists. The emphasis on making cities livable can be explained by reviewing the current state of the cities through the lens of transport and mobility, air quality, etc. (see Table 6). Kakinada's SCP identifies a lack of affordable housing and public facilities such as a comprehensive underground sewerage and storm water drainage system as their major weakness. Whereas, Kanpur lacks a 24*7-electricity supply that disrupts industries and affects the city's economy. Kanpur also has high pollution levels and major sources of pollution include poor treatment facilities at industrial sites. In addition, both cities recognize congested roads, a lack of public transport (with demand met from unorganized private modes), and unorganized parking (with high levels of on street parking reducing the capacity of roads) combined with an unsafe environment for non-motorized traffic and fewer footpaths as other weaknesses.

The interviews with government officials and relevant documents indicated that the officials focused their efforts on identifying the key concerns of citizens and proposing projects that benefit everyone in the city. Upon examination, the SC projects appear more like traditional infrastructure projects, with effort being made to make the cities' current infrastructure, including physical structures such as roads and institutional capacity such as enforcement laws and privacy issues more welcoming to technology-based solutions. An SC expert mentioned similar thoughts, stating the "SC is not a destination but a journey", that provide opportunities for change along the way. Further, he mentioned, "physical infrastructure cannot be treated independently and needs to use technology to plan them well" (K. Kumar, 2018). Therefore, it is not appropriate to wait for the physical infrastructure to be established before including the technology. Instead, both these components are intertwined and cannot be separated. Additionally, since a leapfrogging approach to urban development is currently being adopted in India and other developing nations (K. Kumar, 2018), new and existing

infrastructure needs to be transformed in a way that integrates or accommodates technological advancements.

4.4.4. How will cities become smart?

In a previous study Gupta, Zhang, and Hall (2019), SC risks were explored in the context of Indian SCM, which highlighted that social, institutional, and partnership risks were some of the major barriers to implementing SC projects. This was further explored through interview questions in this research; specifically, respondents were asked, "What is needed to become a Smart City?" One of the industry professionals highlighted that "better coordination between the city departments and willingness to share data and resources across departments should be the first step" to plan and implement mission activities. Similar thoughts were expressed by another industry professional who mentioned, a "Firm and quick decision-making machinery can implement SC projects at a much faster rate." Another industry official described that citizens' cooperation can increase the pace during data collection stages. In addition, one industrial professional emphasized the role of stakeholder collaboration stating,

> "Stakeholder collaboration is important [for SC projects to take off and be sustained,] but this will require time as it involves building trust [amongst the stakeholders] and should not be done in haste".

One of the higher government officials in Kakinada stated,

> "To become a smart city, there is a need to marry technology with the existing process and in order to do so we need to develop built infrastructure that is welcoming to technology."

He further added, "We need more responsible, hygiene caring, and tax-paying citizens [to become a smart city] and we need a strong political will." The city officials in Kakinada

mentioned that with mission activities in progress, there have been changes in the system to ensure accountability, such as a biometric attendance system that is already in place in the local government administration. Another government official mentioned that a "Lack of local contractors [with SC expertise] often delays the project implementation". Further, the city municipality's website provides the relevant information for the citizens such as property tax rates and user fees, birth/death registration, etc. to provide easy access to these services. Further, an online grievance redressal system is in place. The Kakinada SPV (known as Kakinada Smart City Limited) has a website that contains up-to-date information on their SC projects executed and planned for the city (http://139.162.51.246/p/aboutus.php). The officials mentioned that online platforms and citizen-care call centers are promoted to obtain feedback from the citizens to further improve the existing and planned services.

Kanpur's government officials indicated that for Kanpur to become smart, "citizens need to become smart" meaning they need to recognize their duties and come forward to become a part of the mission by contributing to the mission's activities. Some simple contributions they mentioned included "not violating the traffic rules", "not littering the streets", and "judiciously using the public services". Another government official specifically mentioned that students, local businesses, and NGOs are all contributing towards the mission, which is important for the successful implementation of project. For example, Parivartan, a NGO focusing its efforts to make Kanpur cleaner and greener, is organizing activities at the city level in collaboration with Kanpur Municipal Corporation to educate citizens about the importance of sanitation especially in low-income housing areas. Further, the city officials mentioned that for the successful implementation of projects, the information about the mission activities needs to be communicated efficiently to the citizens. For instance, the city's municipality website provides relevant information for citizens related to urban services at

ease. Further, the website for Kanpur SPV named as Kanpur Smart City Limited (https://kanpursmartcity.in/index.html) provides the contact information of city officials associated with the SCM in Kanpur and provides details about ongoing and proposed activities. With the SCM, the accountability and transparency of the city agencies has increased, beginning with a manual employee attendance system in Kanpur. However, an Enterprise Resource Management (ERP) e-Nagar Nigam initiative is planned to improve attendance monitoring and support better urban service delivery. Additionally, a government official stated that support from local leaders is important for such missions to be implemented successfully. However, the government officials in Kanpur recognized that poor operation and maintenance of existing infrastructure and limited interdepartmental coordination reduces worker productivity and efficiency. Further, the officials mentioned that city-level agencies must come together to implement the mission activities in an organized fashion.

In the interviews, it was found that robust institutional machinery, a strong political leadership, and collaborative efforts across various stakeholders, including private partners and citizens, were the most important enablers to successfully implement a SC initiative. Mr. Rajat, CEO of Raipur Smart City, stated in his Ted Talk that a smart city cannot be built without smart citizens, which echoes the above finding. He added that it is not merely the responsibility of the local authorities to build a SC, but active citizen participation was needed to ensure the successful implementation of a project (Bansal, 2018). He further stressed that SCs are “people powered cities” (Bansal, 2018). This can be evidenced by the popularity of SC projects such as the Open gyms in Kakinada and Kanpur and the place-making project of the Naveen Market. With the SCM activities involving a number of stakeholders, developing institutional systems and practices that are more transparent,

accountable, and trustworthy in nature, is important to successfully execute projects in a collaborative manner. Dr. Prashant Dhawan, a SC and bio-mimicry expert mentioned in his Ted Talk “To transform Indian cities into smart cities, we need to focus on feedback loops, inter-relations between the processes, and connections between the subsystems” (Dhawan, 2017).

4.5. Discussion

Boosted by advancement in ICT and IoT platforms, access to mobile technologies, and other technological advancements, a global market for SC initiatives is emerging. Towns, cities, and megacities are approaching the SC concept to plan for more livable and sustainable communities. The definition of livable and sustainable varies from place to place, as does the definition of a SC. This study used the cases of Kakinada and Kanpur to uncover the process of becoming smart. Mostly, both cases identified similar SC goals, components, and outcomes, but this research reveals that the city officials in Kakinada are focusing their efforts on integrating the urban services and using the data generated to plan future urban services. In contrast, city officials in Kanpur are more inclined towards ensuring city safety and planning environmentally sustainable urban development. Moreover, this study finds that although the city officials provided clear statements on what they understand as ‘smart’ development, it is still unclear who their ‘smart’ definition is focused on and what components of a project makes it smart. These are some important questions that the groups planning SC programs need to be very clear about from the start. Further, the interviews with industry professionals indicated that the mission guidelines at the national level are broad enough for cities to develop their own version of a SC. However, this flexibility means that multiple interpretations of the SC concept are possible, potentially making the concept seem fuzzy to government officials who are new to this area.

The proposed SC projects were a mixture of physical infrastructure projects with some technology-based solutions. From the two cases, it was evident that the emphasis of smart city projects is on strengthening the existing physical infrastructure such as road networks and water and waste management systems. However, projects such as the CCC indicate the urgency to improve the safety and law and order in the cities. Further, green space development and open gyms were considered as important projects, which highlights the emphasis given to developing places for citizens to interact. These projects reinforce the cities' vision to improve livability conditions and develop environmentally sustainable places, giving importance to the priorities indicated by citizens. On comparing these SC projects with the projects that have been implemented in developed nations, it was found that although the type of projects that are (proposed to be) implemented in Indian cities lack the technological sophistication that is seen in developed nation SCs, the domains in which these projects focus on are similar. For instance, most SC initiatives were focused on mobility, environment, and energy efficiency.

HITACHI's (a global smart city solution provider) report on envisioning a smart city stated, "Behind the need for smart cities are the external factors that influence people's lives, namely the global environment and the society in which they live" (Yoshikawa, Sato, Hirasawa, Takahashi, & Yamamoto, 2012). These can include climate change, population growth, resource depletion, and the associated adverse effects of urbanization. While exploring why the two cities want to become smart? It was found that like the other SCs in more developed nations of the world, the high-level goals/visions of proposed Indian cities had similar phrases such as inclusive, livable, sustainable, and economically vibrant. However, the underlying objectives and strategies varied. These strategies were in response to the challenges posed by spatially and structurally imbalanced urban development and rapid urbanization in Indian

cities. Further, this distinction arises from factors such as a lack of infrastructure, unplanned settlements, and scarce resources such as land. In addition, many of these urban issues are interconnected, making it difficult to focus the efforts on a single issue. Thus, the proposed SC strategies were focused on providing access to basic urban services such as safe roads, clean water, and improved sanitation to all in addition to embedding few technology solutions such as CCC and ITMS.

Lastly, SC enablers mentioned by the cities and industry professionals were found to be similar to the one mentioned in a developed nation context. However, the cities of Kakinada and Kanpur put less emphasis on an important component – i.e., involvement of higher educational institutions and other research centers. Most developed nations have focused on smart cities in developing their educational curriculum; a lot of research is focused on inventing smart technology and understanding its implementation in cities and its impact on the citizens (Etzkowitz & Leydesdorff, 2000; Hajduk, 2016). In contrast, the concepts of living labs and innovation districts are somewhat foreign to Indian cities, creating an opportunity to further expand the scope of SCs across the nation. There is also a need to introduce more instructional courses related to the SC domain to develop in-country expertise in SC. The SCM is already holding regular conferences where the SC CEOs exchange their ideas related to SC implementation, but there is a need to include SC experts in planning such initiatives, not just at national but local level. Moreover, there is a need for more enthusiasm and courage to experiment and involve small start-ups in SC initiatives, rather than looking at the big planning companies to provide assistance for SC development.

4.6. Conclusion

This study explores the process of two non-metro cities, Kakinada and Kanpur, aspiring to become smart using a retrofitting development model. Unlike other studies that focus on completed SC projects, this research focuses on two cases that are currently undergoing a SC transformation. The findings present an interesting perspective of industry professionals and city officials on: What is smart? Why to become smart? and How to become smart? in a developing nation context. These perspectives are slightly different from those of SCs in developed nations in terms of how 'smartness' in defined. However, the goals and enablers of a SC are found to be similar. It is found that local factors such as a city's urban issues and citizens' perspective shape the proposed SC projects in the cities. Communities (in developing and under developed nations) in advancing a similar concept can use the process of becoming smart presented in this study as a frame of reference. Further, this research can also guide city managers and program directors in developing and under-developed nations to better understand the complex concept of a smart city by breaking the process into goals, components, and enablers. Lastly, this study has also highlighted several questions that need to be addressed in future research such as 'smart for whom? The current research has provided insights from the SC experts involved in implementing projects. However, future research will focus on the perspective of citizens for whom these initiatives are planned which are the citizens.' The research could also be expanded by studying the What, Why, and How of mega smart cities such as Delhi, Chennai, etc. that may have access to better resources, but are also struggling to manage the challenges that come with rapid urbanization.

Chapter 5: CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

The Government of India (GoI), like many national governments has invested in smart city (SC) initiatives to drive economic growth and achieve a better quality of life for its citizens. This study focused on developing an understanding of SC transformation in India's Smart Cities Mission (SCM) by examining the cities of Kakinada and Kanpur, currently implementing smart city projects. This three-paper dissertation studied various aspects of the SCM from the framing of the concept by city officials and industry professionals to the challenges faced in implementing these projects in the cities of Kakinada and Kanpur. A summary of the research gaps, research questions, and contribution of Chapters 2, 3, and 4, representing papers 1, 2, and 3 is provided in Table 8.

Table 8: Summary of Research Gap, Question, and Contribution

Research Gap	Chapter	Research Question	Contribution
• There is limited research on holistic/systematic analysis of SC implementation risks. Several studies have identified these challenges broadly, but lack a detailed discussion of their occurrence frequency, priority, and co-occurrence. • Studies discussing SC implementation challenges are based on cases from developed nations, which misses an opportunity to study challenges present in developing nations and identify appropriate mitigation measures to better respond to SC	2	1. What are the various risks associated with SC Project implementation in developing countries? 2. How do risk priorities change for small- and large-scale projects? 3. What are the possible co-occurrences of the various identified risks? (Research Findings are summarized in **Section 5.1.)**	• Provided a framework to systematically analyze SC implementation risks in a developing nation context by discussing their frequency of occurrence, priorities, and risk co-occurrences. • Compared and contrasted SC risks found in developing and developed nations, suggesting mitigation measures for SC implementation risks in a developing nation.
	3	4. What is the risk landscape for implementing SC projects in the cities of	

Research Gap	Chapter	Research Question	Contribution
implementation challenges.		Kakinada and Kanpur? 5. How can we validate the risk co-occurrences found in the previous chapter? (Research Findings are summarized in **Section 5.1.**)	
• Review of SC models and definitions found in the SC literature are mostly focused on discussing 'smart' with respect to cases found in developed nations and which are already built. There are a few studies that discuss SCs in a developing nation context. Moreover, studies from developing nations highlight mostly cases that are green field projects or are built from the ground up. • Previous studies have discussed SC components, goals, and enablers, but lack a holistic discussion or a way forward for communities planning to implement SC initiatives in a developing nation context.	4	1. What do the cities understand by 'smartness'? 2. Why do cities want to become smart? 3. How will cities become smart? (Research Findings are summarized in **Section 5.2.**)	• Examined SC cases currently undergoing a retrofitting model of SC development in India to provide a frame (including components, goals, and enablers) for other developing nation cities planning to advance SC initiatives. • Found that smart city projects in Kakinada and Kanpur are focused on *External Smartness* of the city than rather than *Internal Smartness* of the city. Thus, SC projects tended to be a mix of physical infrastructure projects with some technology components. However, projects focusing on improving governance and citizen participation were infrequently mentioned by government officials and industry professionals/consultants as being central to a SC. Further, SC enablers such as strong political will, robust institutional machinery, and citizen participation were considered as secondary to the externally-perceived smartness of a city.

Research Gap	Chapter	Research Question	Contribution
• The SC definition has evolved since in the last two decades. However, with recent studies focusing on aspects such as smart governance, smart citizens, and barriers to SC implementation, there is a need to update the SC definition so that it reflects recent developments and serves cities in both developed and developing nations.	5	1. What can be learnt from the three chapters? (Observations are summarized in **Section 5.3.**)	• Developed the two constructs of *External* and *Internal* Smartness of a city that can be used to help a city focus on managing the SC transformation process.

5.1. SC Implementation Risks in a Developing Nation Context

Previous studies on SCs have identified that the current SC scholarship lacks a systematic analysis of risks/challenges that exist in implementing SC projects. In addition, there are very few studies that discuss the SC risks present in a developing nation context. Chapters 2 examines 33 Smart City Proposals (SCPs) submitted to the GoI under the Indian SCM and provides a framework to systematically analyze the risks identified in the SCPs. Further, Chapter 3 validates the risks identified in Chapter 2 in the cities of Kakinada and Kanpur and explores causal linkages between the identified risks by analyzing the interviews conducted with city government officials and industry professionals. Chapters 2 and 3 explored and answered the following questions.

1. **What are the various risks associated with SC project implementation in developing countries?**

   Chapter 2 classifies the SC implementation risks into eight categories, namely, Social, Institutional, Scheduling and Execution, Financial, Partnership and Resource Management,

Technology, Environmental risk (and risks due to Natural Hazards), and Political risk. These risk categories are mentioned in the order of their frequency of occurrence with Social risk being mentioned the most.

2. How do risk priorities change for ABD and PAN projects?

Chapter 2 discusses that projects across scales share similar categories of implementation risks. For instance, both ABD and PAN risk statements recognized Institutional risk, Social risk, and Financial risk as a High-priority risk. The risk analysis highlights several dissimilarities in ABD and PAN risk statements. For example, Scheduling and Execution risks and Technology risks are perceived differently in ABD and PAN projects and are typically considered as more critical in PAN projects. Further, the risk priority analysis informs that frequently mentioned risks may not be the ones that require urgent attention.

3. What are the possible co-occurrences of the various identified risks?

Chapter 2 highlights the risk co-occurrences indicating possible connections between the risk categories in the ABD and PAN risk network. Although risk co-occurrences are differently distributed in both the risk networks, Institutional risk is observed to frequently co-occur with Scheduling and Execution risk, Social risk, Partnership and Resources risk, Technological risk, and Financial risk. These risk co-occurrences may affect the implementation of SCM projects suggesting different mitigation measures may need to be developed to manage small and large-scale projects, respectively.

4. What is the risk landscape in the cities of Kakinada and Kanpur?

Chapter 3 discusses the seven SC implementation risks identified from interviewing city government officials and industry professionals. The seven risks are Partnership and Resource Management, Institutional, Scheduling and Execution, Social, Political, Technology, and Financial. These risk categories are mentioned in the order of their frequency of occurrence with Partnership and Resource Management being mentioned the most. Further, Chapter 2 describes the perspective of city officials and industry professionals on risk priorities for the two cities. In addition, Chapter 2 highlights the difference in risk priorities for the two cities based on their local context.

5. **How can we validate the risk co-occurrences found in Chapter 2 using the cases of Kanpur and Kakinada?**

Chapter 3 discusses the method to model risk linkages using causal mapping of the interview data obtained from SC experts (industry professionals and local government officials) and reveals the closely connected risks. For example, Institutional risks affected several other risks directly and indirectly. The research suggests that city managers need to take a holistic view towards risk and their possible interconnections, when proposing risk mitigation strategies instead of responding to each risk in isolation.

5.2. SC Goals, Components, and Enablers

Chapter 4 examines two proposed SCs in India – Kakinada and Kanpur – that are currently implementing SC projects to explore their SC transformation process that is based on a retrofitting model (brownfield development).

1. What do cities of Kakinada and Kanpur understand by ‘smart’?

Chapter 4 describes that the proposed SC projects are a mixture of physical infrastructure projects with some technology-based solutions. From the two cases, it seems evident that the emphasis of smart city projects is on strengthening the existing physical infrastructure such as road networks and water and waste management systems. However, similar SC projects are seen as having different outcomes for the two cities. Further, the interviews indicate that the term ‘smart’ is understood slightly differently by the industry professionals and city officials. It is interesting to note that the industry professionals defined ‘smartness’ with respect to the users (citizens, in this case) while the city officials focused on the process. For example, using data to plan cities.

2. Why do cities of Kakinada and Kanpur want to become smart?

Chapter 4 reveals that although the high-level goals of the proposed SCs in India are similar to those of existing SCs in developed regions, the underlying objectives and strategies vary and are shaped by critical urbanization challenges faced by the cities. These strategies were in response to the challenges posed by spatially and structurally imbalanced urban development and rapid urbanization in Indian cities. Further, this distinction arises from factors such as a lack of infrastructure, unplanned settlements, and scarce resources such as land. In addition, many of these urban issues are interconnected, making it difficult to focus the efforts on a single issue. Thus, the proposed SC strategies are focused on providing access to basic urban services such as safe roads, clean water, and improved sanitation to all in addition to embedding few technology solutions such as CCC and ITMS.

3. How will cities of Kakinada and Kanpur become smart?

Chapter 4 discusses that robust institutional machinery, a strong political leadership, and collaborative efforts across various stakeholders, including private partners and citizens, are the most important enablers to successfully implement a SC initiative. SC enablers mentioned by the cities and industry professionals are found to be similar to the one mentioned in a developed nation context. However, the cities of Kakinada and Kanpur put less emphasis on an important component – i.e., involvement of higher educational institutions and other research centers.

5.3. Findings across Chapters 2, 3, and 4

Chapter 2, 3, and 4 contribute to the discussion of how smart cities in the future could be described and defined. The SC literature surveyed for these studies also highlighted that the focus of a SC has shifted over time, from a focus on the technology itself to the outcome of applying that technology (shown in Figure 13). Furthermore, recent SC studies indicate that the discussion of SCs is now being focused on processes and people, which will likely include the challenges facing stakeholders involved in a SC transformation. Consequently, the SC concept may now need to focus on how cities are undergoing a SC transformation. Lastly, this research describes a city's smartness as *Internal* and *External* Smartness, which are briefly described in the following sections. Strategies to strengthen a city's internal smartness are also discussed.

5.3.1. Evolution of Smart Cities

In late 1990s, studies discussing SC models and definitions were mostly technology focused and introduced by technology giants like IBM and CISCO in majorly advanced countries of North America and Europe, aiming at profit maximization (Söderström et al., 2014). Several researchers have criticized these SC studies that focused only on a technocratic definition of SCs (Hollands, 2008). Further, SC studies in the period of late 2000 especially post 2010 introduced SC definitions focused on the outcome of using smart technologies (Bakıcı, 2013). For instance, using technology tools to improve the quality of life of citizens. This outcome can be attributed to the fact that most SC studies discussed cities as cases that have already implemented SC projects. Thus, SC studies tended to focus on a city's physical aspects such as solid waste management, smart roads, smart buildings, etc. In addition, these studies were also based on cases from both advanced and emerging nations. Post 2010, several studies have discussed factors enabling or hampering SC development, and have highlighted the role of stakeholders, especially citizen participation, in successfully implementing a SC initiative. However, there are few studies that explore the SC transformation process in a developing nation context. In order to examine this process and the various stakeholders who engage with the process, it is important to study diverse cases (in developed and developing nations) where SC projects are currently being

implemented.

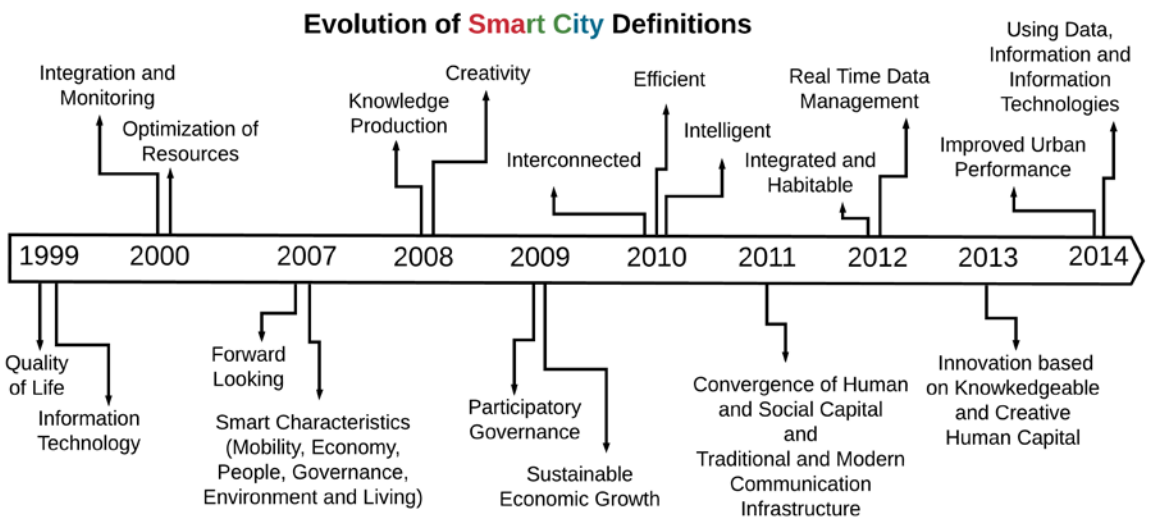


Figure 13: Evolution of Smart City Definition over the years (Gupta and Hall, 2016).

Based on the evolution of SC definitions and/or concept in the SC literature, this study focuses on the need to understand the SC transformation process and to use this understanding to enhance the framing the SC concept. Further, this research highlights the need to examine implementation risks that may shape SCs in a particular context. SC implementation risks identify several weaknesses of a city in terms of attributes that are essential for effective SC implementation, such as a lack of a) governance of urban local bodies, b) citizen engagement, c) availability of technology and technical expertise to implement technology projects, and d) strong leadership at the local level. Furthermore, this research suggested that identified risks such as Institutional risks and Scheduling and Execution risks and their causal linkages are a result of fairly broad existing smart city guidelines at the federal level and weak organizational and governance capacities at the city level. Chapters 2 and 3 discuss these risks that cause implementation delays of SC projects in Indian cities. These implementation risks highlight the

need to explore how SCs in India are envisioned in terms of components, goals, and enablers of a SC (discussed in Chapter 4).

The study discussed in Chapter 4 focuses on the perspective of city government officials and industry professionals in Kanpur and Kakinada on the SC transformation occurring in the cities. The interviews indicated that both groups envisioned SCs as mostly a physical transformation. For example, most SC projects that were mentioned include mobility projects that would improve traffic management, solid waste management that would result in effective utility services, etc. However, components such as building transparency, improving citizen participation, and better collaboration with private partners and other stakeholders were rarely mentioned. Although the interviewees highlighted crucial implementation risks and discussed enablers that may result in successful SC project implementation, these enablers were not discussed as SC components that need to be developed as a part of transforming a city into a smart city.

5.3.2. Redefining a Smart City

Previous SC models by Giffinger et al. (2007) and Cohen (2014) described a smart city as a combination of six urban domains namely smart living, smart economy, smart environment, smart governance, smart people, and smart mobility. This research found that these six domains can be grouped into city attributes, which define *Internal* and *External* Smartness of a City (as described in the Figure 14). This exploratory research identified these two constructs that need validation through additional research.

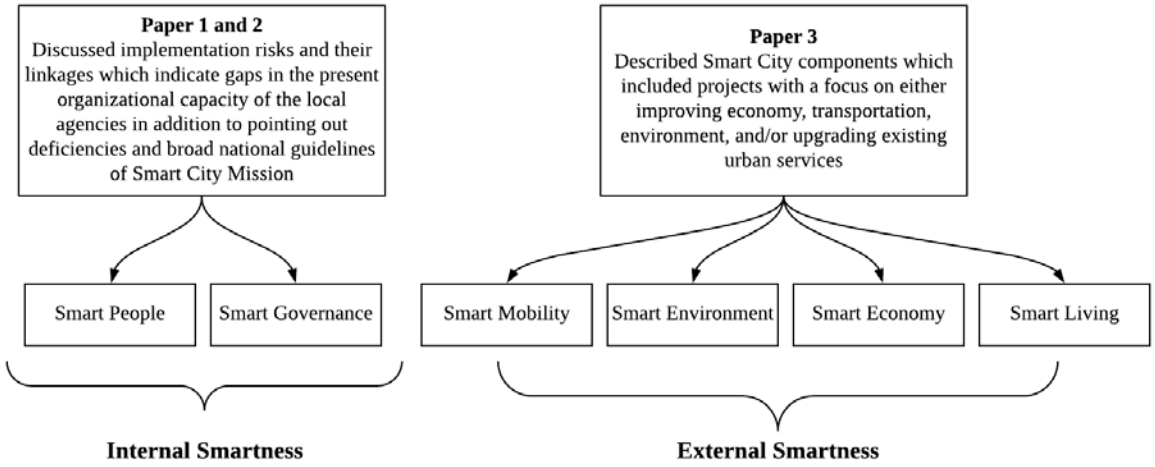


Figure 14: Internal and External Smartness of a city.

External Smartness of a city consists of attributes/projects/documents that can be physically seen and result in improving mobility, upgrading urban services using smart solutions, and reducing energy usage by the city. On the other hand, Internal smartness of a city may include processes that result in SC transformations that involve of citizens, promote collaboration among stakeholders implementing SC activities at the city level, devise ways to integrate existing urban services with the proposed services, and innovate enforcement mechanisms at the local level. The findings from Chapter 4 describe in detail projects that focus on a city's external smartness. However, experiences from the previous urban missions in India have shown that a lack of internal smartness (including collaboration challenges, etc.) have impacted project implementation (An, 2015). It is therefore important for the cities and mission directors to focus on making cities internally smart and develop policies accordingly. A lack of internal smartness has resulted in various implementation risks and their causal linkages as described in Chapters 2 and 3. For instance, Institutional risks that may cause other risk categories such as Partnership and Resource Management risks (described in Chapter 3) are often a result of a lack of robust

institutional machinery, local governance challenges, and gaps in the broad SCM implementation guidelines.

Mission directors of the SCM, unlike previous urban missions, introduced several steps to improve a city's internal smartness, such as creating a Special Purpose Vehicle (SPV) for each proposed smart city to improve local governance and SC implementation. These newly formed SPVs (which mostly comprise of members from existing municipalities and other local bodies) have representation from city, state, and central government. Document analysis of Smart City Proposals (SCP) and related annexures highlighted several shortcomings of the SPVs that were formed. Each SCP included a diagram of their SPV's organogram that is also referred to as an organizational chart. The available organograms of SPVs showed that most SPV's officials are a part of other local agencies and are already involved in one or more city related projects. Further, a preliminary comparison of SPVs' organograms reveals that each SPV has a different structure that was framed by respective city government officials. Figure 18 and Figure 19 show the organogram of the Kakinada and Kanpur SPV. The two organograms fail to describe the organizational structure of the SPV and therefore lack information on the role played by each agency within SPV and the kinds of interactions between these agencies. It is observed that the organogram of Kanpur's SPV is better organized and structured than Kakinada's SPV, which could be a result of Kakinada (Round 1) and Kanpur (Round 2) being selected in different rounds. Thus, Kanpur city officials may have had an opportunity to learn from the SPV structures of various cities in Round 1 and improve on their structure. The diversity in SPV's organogram could also be linked with the broad SCM guidelines that lacked clarity on how a

typical SPV should be formed. As a consequence, each city under the SCM has a different SPV model, which undermines the capacity of the GoI to implement its mission activities strategically. The SPVs studied were also found to be understaffed. Based on interactions with the SPV officials, it was confirmed that city officials are under tremendous pressure from the day-to-day pressure of urban issues facing a city. Consequently, the officials have less time to dedicate on smart city projects. These challenges may overshadow the purpose of SPV creation.

5.4. Recommendations for the cities of Kakinada and Kanpur

Based on the research findings, there is a need to recruit experts who have experience in implementing SC projects in the core team of an SPV to increase their capacity and efficiently manage SC mission implementation at the local level. For instance, SC Columbus, Ohio (United States) created specific positions to better manage their workload and has been successful in implementing projects (Berst, 2018). It is recommended that specific positions be created in the SPV that relate to Risk Analysis, Innovation, Data Management, Technology, Marketing, and Branding. These positions may be temporary/contractual, but will help in distributing the workload among the SPV team members and may result in efficient deliverables. The following list describes some of the positions that could be created to improve the internal smartness of a city and may result in speeding up SC implementation by reducing institutional risks.

1. A Risk Analysis Specialist(s) would be responsible for identifying the SC implementation risks present in the city and carrying out risk analyses to identify mitigation strategies.

2. A Chief Innovation Officer for each SPV would be responsible for proposing projects that can result in obtaining more than one primary outcome and innovating current projects.

3. An Enforcement Officer would be responsible for reaching out and coordinating with the police department to ensure law enforcement is appropriate applied in the city.

4. More than one Chief Data Officers would be required. Once the cities start collecting data, they may find themselves overwhelmed by the sheer volume of data collected. Officers in this position should have data collection and management expertise.

5. A Communication Officer/Branding Team would be an essential addition to the current SPV structure as citizens need to be made aware about the projects being proposed for the city in addition to weekly/monthly updates on SCM progress at the city level, the national standing of the city, etc.

Smart Cities in developed nations have successfully implemented projects by improving their organizational capacity. However, in adapting some of these recommendations to an Indian context, the value proposition of adding more specialists and restructuring the current SPVs needs to be understood. Such changes will require both political will and support from the mission directors and local authorities planning and implementing SC projects. Moreover, support from SC experts and academics will be essential for training and supporting the professionals included in an SPV. In addition, the use of SC's funds to implement these recommendations would need to be permitted.

Current SC implementation scholarship and research findings from the city of Kakinada and Kanpur have showed that citizen participation/engagement is a prerequisite for successfully implementing a project. Projects such as Open gyms have been successful because of citizens' involvement that resulted from citizens seeing the value in this project. Citizen engagement has been a challenge not just in the Indian SCM, but is a hurdle in cities of more advanced economies such as United States, Canada, Austria, and Australia (Chapter 2). This calls for informing and engaging citizens in creating awareness about the SC projects being implemented and proposed. In addition, updating the citizens and being transparent about the mission implementation. This will cultivate trust amongst the citizens, which would be supported by identifying the various channels/mediums through which information is circulated to the citizens. For instance, using Radio to engage citizens in planning next steps of the SCM at the city level and update them about the current implementation status. Marketing/Branding team can help in this direction.

5.5. Limitations and Future Research

Several future research directions could be explored. First, the findings of this research indicate two constructs, namely, Internal and External Smartness of a city. These constructs need further exploration and validation and can then be used to develop metrics to gauge cities' smartness. Figure 15 depicts a Smart City tree using the proposed constructs, External and Internal Smartness, where, External Smartness components are readily visible (comparing these components with stem and leaves of a tree) while Internal Smartness components are the ones

which are not visible yet necessary for the growth of a tree (like roots). The internal components, like roots, are essential for a Smart City to develop.

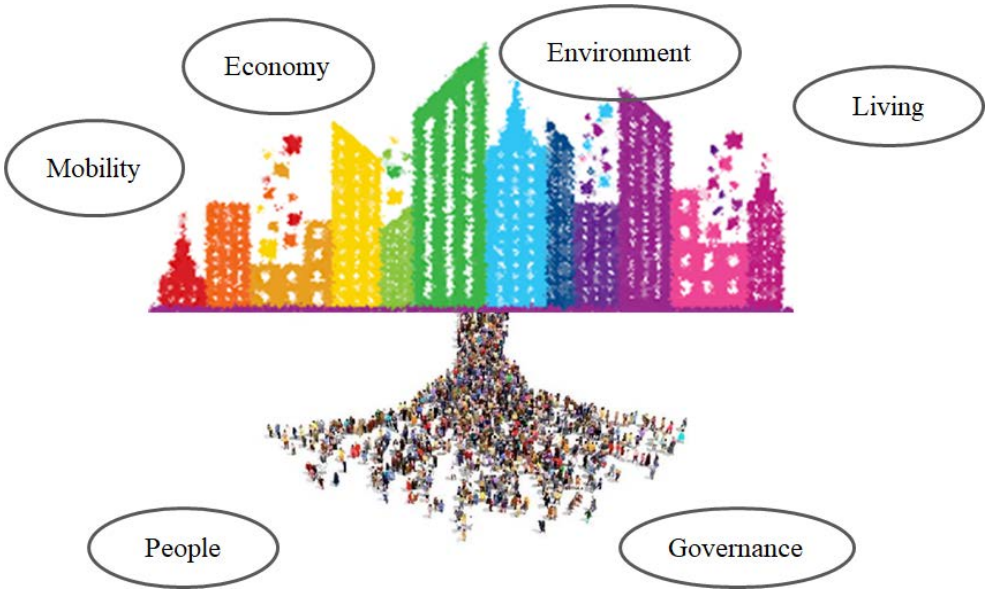


Figure 15: Depiction of a Smart City in terms of Internal and External Smartness

Previous studies have extensively discussed the proposed construct of External Smartness, by studying components such as Smart Environment, Smart Economy, Smart Mobility, and Smart Living (briefly discussed in Table 9).

Table 9: Description of External Smartness Components

Smart Urban Domains	**Brief Description**

Smart Urban Domains	Brief Description
Mobility and Transportation	The objective of 'Smart Mobility and Transportation' is to reduce traffic congestion, reduce air and noise pollution, improve transfer speed, ensure people's safety, and reduce transfer cost (Benevolo, Dameri, & D'Auria, 2016; Lazaroiu & Roscia, 2012). These objectives can be achieved by: • Optimizing logistics and transportation in urban areas by taking into account traffic conditions and energy consumption through ICT tools (Cohen, 2014; Giffinger et al., 2007). • Providing users with dynamic and multi-modal information for traffic and transport efficiency (Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014). • Assuring sustainable public transportation by means of environment-friendly fuels and innovative propulsion systems, such as use of hybrid cars and car-sharing, and by encouraging Pedestrian areas and Cycle lanes (Lazaroiu & Roscia, 2012). • Using technology infrastructure such as smart cards, mobility app, etc. (Neirotti et al., 2014). Based on the above factors, it can be said that ICT is a pivotal, but not a necessary technology to start the implementation of Smart Mobility and Transportation initiatives; its importance however increases when the complexity and the maturity of Smart Mobility projects become higher. In ITS or other integrated Smart Mobility policies, ICT plays a crucial and fundamental role.
Environment	The objective of 'Smart Environment' is to ensure environmental protection (Giffinger et al., 2007), sustainable resource management, lower pollution levels, and attractiveness of natural conditions (V. T. M. Kumar & Dahiya, 2017). Some of these objectives can be achieved by the contribution of ICT sensors for environmental measurement and for buildings' energy capacity's evaluation; smart grids deployment for energy production and delivery in the city; and encouragement of smart solutions for renewable energy production (Lazaroiu & Roscia, 2012).
Economy	The objective of 'Smart Economy' is to foster new entrepreneurial initiatives, an increase of competitiveness and high productivity in communities with the aim of improving the quality of life (Giffinger et al., 2007). This model of Smart Economy is based on a series of concepts to promote the development, sustainability and attractiveness for new investment. The main concepts are: e-business, e-commerce, increase of productivity, employment and innovation (Cohen, 2014) and generation of new products and services, new models, local and global interconnectedness (V. T. M. Kumar & Dahiya, 2017), and opportunities for business and entrepreneurship (Tyas et al., 2019).
Living	The objective of 'Smart Living' is to improve social wellbeing of a city using ICT. This includes better healthcare and education facilities (Nam & Pardo, 2011), public security and safeguarding cities from natural calamities and/or disasters, promoting cultural events and motivating people participation, managing entertainment, tourism and hospitality, and reducing barriers to social inclusion (Giffinger et al., 2007; Neirotti et al., 2014).

However, few studies discuss a city's Internal Smartness, including Smart Governance and Smart People. Several future research directions could be explored. First, the findings of this research indicate two constructs, namely, Internal and External Smartness of a city. These constructs need further exploration and validation using Mix Method Research Design. These constructs can then be used to develop metrics to gauge cities' smartness. Further, SPVs can act as a game changer for cities in implementing SC projects and therefore need to be analyzed. Future research should focus on cities that are performing better and ranked in the top 10 in India to begin exploring their SPV's structure and attributes related to internal smartness. Researchers who have studied Smart Governance and Smart People have based their discussion on the cases from the European Union and the United States. Some of these studies indicate that the objective of 'Smart Governance' is to allow collaboration, data exchange, service integration (Odendaal, 2003), and is widely represented by a collection of technologies, people, policies, practices, resources, social norms, and information that interact to support city governing activities (Chourabi et al., 2012). Further, Smart Governance is built upon governance infrastructure that should be accountable, responsive, and transparent (Mooij, 2003). On the other hand, (Giffinger et al., 2007) describes 'Smart People' in reference to aspects such as an individual's qualifications, participation in public life, and affinity to lifelong learning.

In order to develop an understanding of Internal Smartness, including, Smart Governance and Smart People in the context of India, there is a need to first unpack urban governance in Indian cities, which are still rapidly developing unlike cities in the EU and US. The proposed future study, entitled 'Smart City Implementation to Smart City Realization - Cases from India', will be

focused on understanding and building the construct 'Internal Smartness' using: 1) Urban Regime theory (da Cruz, Rode, & McQuarrie, 2019) to explore the network of enabling institutions, including vertical and horizontal sharing of information and resources, and engagement of civil society with decision-making of ULBs (Heller, Mukhopadhyay, & Walton, 2016); 2) Project Management theories (Shenhar & Dvir, 2007; Yamin & Sim, 2016) to highlight the importance of project leadership, project design and monitoring, and the role of stakeholder coordination in successful implementation of SC projects; and 3) examples from the Capacity Building literature (Ajoy Datta, Shaxson, & Pellini, 2012; Ika & Donnelly, 2017; Yalegama, Chileshe, & Ma, 2016) to address the capacity constraints facing an implementing agency, which in this case is the Special Purpose Vehicle (SPV). SPVs can act as a game changer for cities in successfully implementing SC projects and therefore need to be examined. Future research will examine the SPVs of the top 20 cities in the SCM that are performing better than other cities in the program to begin exploring their structure and attributes related to Internal Smartness.

Second, current research focuses on cities from Tier II and III that are smaller and less populous cities. Future research can explore bigger cities such as Chennai, Delhi, and Bangalore. These cities have access to better resources and expertise; however, they also witness large-scale urbanization challenges when compared to cities such as Kakinada and Kanpur. Further, it will be interesting to compare and contrast the findings on implementation risks between Tiers I, II and III cities of India.

Third, Chapter 4 focused on exploring *What*, *Why*, and *How* of SC transformation and provided a perspective of SC experts, but it is equally important to examine the question *Smart Cities for*

Whom? Put differently, future research needs to focus on understanding the citizen's perspective of smart city in a developing country.

References

Ahluwalia, I. J. (2017). Urban governance in India. *Journal of Urban Affairs*, 1-20.

Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities? *Cities, 60*, 234-245.

Aijaz, R., & Hoelscher, K. (2015). India's Smart Cities Mission: An Assessment. *ORF Issue Brief, 124*, 1-12.

Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart Cities: Definitions, Dimensions, Performance, and Initiatives. *Journal of Urban Technologies*.

An, Y. (2015). *The Operationalization of Capacity Development: The Case of Urban Infrastructure Projects in India*. (Doctor of Philosophy), the Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Angelidou, M. (2015). Smart cities: A conjuncture of four forces. *Cities, 47*, 95-106.

Angelidou, M., Psaltoglou, A., Komninos, N., Kakderi, C., Tsarchopoulos, P., & Panori, A. (2018). Enhancing sustainable urban development through smart city applications. *Journal of Science and Technology Policy Management, 9*(2), 146-169.

Anthopoulos, L., & Fitsilis, P. (2009). *From online to ubiquitous cities: The technical transformation of virtual communities*. Paper presented at the International Conference on e-Democracy.

Aven, T. (2015). *Risk analysis*: John Wiley & Sons.

Baka, J. (2013). The political construction of wasteland: governmentality, land acquisition and social inequality in South India. *Development and Change, 44*(2), 409-428.

Bakharia, A. (2016). Topic modeling with scikit learn. Retrieved from https://medium.com/mlreview/

Bakıcı, T., Almirall, E., & Wareham, J. . (2013). A smart city initiative: the case of Barcelona. , 4(2), 135-148. *Journal of the Knowledge Economy, 4*(2), 135-148.

Bansal, R. (Producer). (2018). Smart City, Smart Citizen *TEDxNITRaipur*. Retrieved from https://www.youtube.com/watch?v=76_p_LGVXVs&t=1197s

Bawany, N. Z., & Shamsi, J. A. (2015). Smart city architecture: Vision and challenges. *International Journal of Advanced Computer Science and Applications, 6*(11), 246-255.

Belissent, J. (2011). The core of a smart city must be smart governance. *Forrester Research Inc., Cambridge Google Scholar*.

Bellamy, C., & Taylor, J. (1996). New information and communications technologies and institutional change: The case of the UK criminal justice system. *International Journal of Public Sector Management, 9*(4), 51-69.

Benevolo, C., Dameri, R. P., & D'Auria, B. (2016). Smart mobility in smart city *Empowering Organizations* (pp. 13-28): Springer.

Benner, C. (2003). Learning communities in a learning region: The soft infrastructure of cross firm learning networks. *Environment Planning, 35*, 1809-1830.

Bhattacharya, S., Rathi, S., Patro, S. A., & Tepa, N. (2015). Reconceptualising smart cities: a reference framework for India. *CSTEP-Report-2015-03*.

Bird, S., Klein, E., & Loper, E. (2009). *Natural language processing with Python: analyzing text with the natural language toolkit*: " O'Reilly Media, Inc.".

Botta, A., De Donato, W., Persico, V., & Pescapé, A. (2016). Integration of cloud computing and internet of things: a survey. *Future generation computer systems, 56*, 684-700.

Boykova, M., Ilina, I., & Salazkin, M. (2016). The Smart City approach as a response to emerging challenges for urban development. *Форсайт, 10*(3 (eng)).

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology, 3*(2), 77-101.

Brett, M. R. (2012). Topic modeling: a basic introduction. *Journal of digital humanities, 2*(1), 2-1.

Bruton, G. D., Dess, G. G., & Janney, J. J. (2007). Knowledge management in technology-focused firms in emerging economies: Caveats on capabilities, networks, and real options. *Asia Pacific Journal of Management, 24*(2), 115-130.

Budde, P., & Wansink, K. (2010). Global–Key Telecoms, Mobile and Broadband Statistics. *Bucketty, NSW: BuddeComm*.

Bulkeley, H., McGuirk, P. M., & Dowling, R. (2016). Making a smart city for the smart grid? The urban material politics of actualising smart electricity networks. *Environment and Planning A: Economy and Space, 48*(9), 1709-1726.

Caprotti, F., Cowley, R., Datta, A., Broto, V. C., Gao, E., Georgeson, L., . . . Joss, S. (2017). The New Urban Agenda: key opportunities and challenges for policy and practice. *Urban Research & Practice, 10*(3), 367-378.

Caragliu, A., Del Bo, C., & Nijkamp, P. (2009). Smart Cities in Europe, Series Research Memoranda 0048. *VU University Amsterdam, Faculty of Economics, Business Administration and Econometrics*.

Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology, 18*(2), 65-82.

Caragliu, A. S. (2011). Smart cities in Europe. *Journal of Urban Technology, 18*, 65-82.

Chauvin, J. P., Glaeser, E., Ma, Y., & Tobio, K. (2017). What is different about urbanization in rich and poor countries? Cities in Brazil, China, India and the United States. *Journal of Urban Economics, 98*, 17-49.

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., . . . Scholl, H. J. (2012). *Understanding Smart Cities: An Integrative Framework* Paper presented at the 45th Hawaii International Conference on System Sciences.

Clarke, V., & Braun, V. (2013). Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The psychologist, 26*(2), 120-123.

Coe, A., Paquet, G., & Roy, J. (2001). E-governance and smart communities: a social learning challenge. *Social science computer review, 19*(1), 80-93.

Cohen, B. (2014). The Smartest Cities in the World 2015: Methodology. Retrieved from http://www.fastcoexist.com/3038818/the-smartest-cities-in-the-world-2015-methodology

Cowley, R., Joss, S., & Dayot, Y. (2018). The smart city and its publics: insights from across six UK cities. *Urban Research & Practice, 11*(1), 53-77.

Curtis, P., & Carey, M. (2012). Risk assessment in practice. Retrieved from https://www2.deloitte. com/content/dam/Deloitte/global/ Documents/Governance-Risk-Compliance/dttl-grc-riskassessmentinpractice.pdf.

da Cruz, N. F., Rode, P., & McQuarrie, M. (2019). New urban governance: A review of current themes and future priorities. *Journal of Urban Affairs, 41*(1), 1-19.

Dameri, R. P. (2017). *Smart City Implementation*: Springer.

Datta, A. (2015). New urban utopias of postcolonial India: 'Entrepreneurial urbanization'in Dholera smart city, Gujarat. *Dialogues in Human Geography, 5*(1), 3-22.

Datta, A., Shaxson, L., & Pellini, A. (2012). Capacity, complexity and consulting. *Lessons from managing capacity development projects. London: Overseas Development Institute*.

Deakin, M. (2015). Smart Cities and the Internet: From Mode 2 to Triple Helix Accounts of Their Evolution *Handbook of Research on Social, Economic, and Environmental Sustainability in the Development of Smart Cities* (pp. 26-43): IGI Global.

Department for Business Innovation and Skills. (2013). *Smart Cities: Background Paper*. Retrieved from London: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/246019/bis-13-1209-smart-cities-background-paper-digital.pdf

Desdemoustier, J., Crutzen, N., & Giffinger, R. (2019). Municipalities' understanding of the Smart City concept: An exploratory analysis in Belgium. *Technological Forecasting and Social Change, 142*, 129-141.

Dhawan, P. (Producer). (2017). Are 'smart cities' really smart? Lets ask nature/Biomimicry! . Retrieved from https://www.youtube.com/watch?v=doVRMBPUOhA

Doshi, S. (2015). Rethinking gentrification in India: displacement, dispossession and the spectre of development. *Global gentrifications: Uneven development and displacement*, 101.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research policy, 29*(2), 109-123.

Fahey, L., & Narayanan, V. K. (1989). Linking changes in revealed causal maps and environmental change: An empirical study. *Journal of Management Studies, 26*(4), 361-378.

Fairley, R. (1994). Risk management for software projects. *IEEE software, 11*(3), 57-67.

Ford, J. D., & Hegarty, W. H. (1984). Decision makers' beliefs about the causes and effects of structure: An exploratory study. *Academy of Management Journal, 27*(2), 271-291.

Fourie, C. J. (2011). *A Modular Course in Project Management* (15 ed.). University of Stellenbosch: Department of Industrial Engineering.

Fromhold-Eisebith, M. (2017). Cyber–Physical Systems in Smart Cities–Mastering Technological, Economic, and Social Challenges. *Smart Cities: Foundations, Principles, and Applications*, 1-22.

Fromhold-Eisebith, M., & Eisebith, G. (2019). What can Smart City policies in emerging economies actually achieve? Conceptual considerations and empirical insights from India. *World Development, 123*, 104614.

Gaffney, C., & Robertson, C. (2018). Smarter than smart: Rio de Janeiro's flawed emergence as a smart city. *Journal of Urban Technology, 25*(3), 47-64.

Garau, C. (2014). Smart paths for advanced management of cultural heritage. *Regional Studies, Regional Science, 1*(1), 286-293.

Gauba, R. (2017). Improving Urban Infrastructure. *Indian Journal of Public Administration, 63*(2), 165-175.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., & Meijers, E. (2007). *Smart Cities: Ranking of European Medium-Sized Cities*. Retrieved from Vienna, Austria

http://www.smartcities.eu/download/smart_cities_final_report.pdf

Goodrick, D. (2014). Comparative case studies. *Methodological briefs: Impact evaluation, 9*.

Granier, B., & Kudo, H. (2016). How are citizens involved in smart cities? Analysing citizen participation in Japanese``Smart Communities". *Information Polity, 21*(1), 61-76.

Greene, D., O'Callaghan, D., & Cunningham, P. (2014). *How many topics? stability analysis for topic models.* Paper presented at the Joint European Conference on Machine Learning and Knowledge Discovery in Databases.

Grimaldi, D., & Fernandez, V. (2017). The alignment of University curricula with the building of a Smart City: A case study from Barcelona. *Technological Forecasting and Social Change, 123*, 298-306.

Gupta, K., & Hall, R. P. (2016). *A comparative study of the concept of smart cities in United States, Europe, and India*. Paper presented at the Smart Cities Innovation Summit, Austin, TX.

Gupta, K., & Hall, R. P. (2017). *The Indian perspective of smart cities.* Paper presented at the 2017 Smart City Symposium Prague (SCSP), Prague, Czech Republic.

Gupta, K., Zhang, W., & Hall, R. P. Risk Priorities and Co-occurrences in smart city project implementation: Evidence from India's Smart Cities Mission. *(Under review)*.

Hajduk, S. (2016). The concept of a smart city in urban management. *Business, management and education, 14*(1), 34-49.

Hamilton, S., & Zhu, X. (2017). Funding and financing smart cities. *The Journal of Government Financial Management, 66*(1), 26-33.

Hamza, K. (2016). Smart city implementation framework for developing countries: The case of Egypt *Smarter as the New Urban Agenda* (pp. 171-187): Springer.

Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., & Williams, P. (2010). Foundations for Smarter Cities. *IBM Journal of Research and Development, 54*(4).

Hartemink, N. (2016). Governance Processes in Smart City Initiatives: Exploring the implementation of two Dutch Smart City Projects: TRANSFORM-Amsterdam and TRIANGULUM-Eindhoven.

Heberle, C. L., & Kackar, A. (2006). Connecting smart growth and brownfields redevelopment. *University of Louisville-Center for Environmental Policy and Management and US Environmental Protection Agency (http://cepm. louisville. edu/publications/PDF_docs/)*.

Heller, P., Mukhopadhyay, P., & Walton, M. (2016). Cabal city: Regime theory and Indian urbanization. *Watson Institute for International and Public Affairs Research Paper*(2016-32).

Hoelscher, K. (2016). The evolution of the smart cities agenda in India. *International Area Studies Review, 19*(1), 28-44.

Hollands, R. G. (2008). Will the real smart city please stand up? . *City, 12*(3), 303-320.

Ibrahim, A., Price, A., & Dainty, A. (2006). The analysis and allocation of risks in public private partnerships in infrastructure projects in Nigeria. *Journal of Financial Management of Property and Construction, 11*(3), 149-164.

Ika, L. A., & Donnelly, J. (2017). Success conditions for international development capacity building projects. *International Journal of Project Management, 35*(1), 44-63.

International City/County Management Association. (2016). Smart Cities Survey. *in partnership with Smart Cities Council*. Retrieved from https://icma.org/sites/default/files/308621_smartcity_snapshot.pdf

Joshi, S., Saxena, S., & Godbole, T. (2016). Developing smart cities: An integrated framework. *Procedia Computer Science, 93*, 902-909.

Joss, S., Cowley, R., & Tomozeiu, D. (2013). Towards the 'ubiquitous eco-city': an analysis of the internationalisation of eco-city policy and practice. *Urban Research & Practice, 6*(1), 54-74.

Joss, S., & Molella, A. P. (2013). The eco-city as urban technology: Perspectives on Caofeidian international eco-city (China). *Journal of Urban Technology, 20*(1), 115-137.

Kakinada Smart City. (2016). *Kakinada Smart City Proposal*. Retrieved from http://smartcities.gov.in/upload/uploadfiles/files/kakinadaSCP.pdf

Kandpal, V., Kaur, H., & Tyagi, V. (2017). Smart city projects in India: Issues and challenges.

Kanpur Smart City. (2016). Kanpur Smart City Proposal. Retrieved from https://smartnet.niua.org/sites/default/files/resources/Kanpur_SCP.pdf

Kartman, G., Sandnes, A., & Smit, G. (2011). Creating municipal infrastructure-A reference guide from smart cities. *European Commission*.

Kim, J. S. (2016). *Mapping Conflicts in the Development of Smart Cities: the Experience of Using Q Methodology for Smart Gusu Project, China.* Paper presented at the Journal or Publication Title REAL CORP 2016–SMART ME UP! How to become and how to stay a Smart City, and does this improve quality of life? Proceedings of 21st International Conference on Urban Planning, Regional Development and Information Society.

Kitchin, R. (2015). Making sense of smart cities: addressing present shortcomings. *Cambridge Journal of Regions, Economy and Society, 8*(1), 131-136.

Kogan, N., & Lee, K. J. (2014). Exploratory research on success factors and challenges of Smart City Projects. *Asia Pacific Journal of Information Systems, 24*(2), 141-189.

Komninos, N., & Tsarchopoulos, P. (2013). Toward intelligent Thessaloniki: From an agglomeration of apps to smart districts. *Journal of the Knowledge Economy, 4*(2), 149-168.

Kotb, M. H., & Ghattas, M. M. (2017). An overview of risk identification barriers with implementation of PMI standards in construction projects.

Kuang, D., Choo, J., & Park, H. (2015). Nonnegative matrix factorization for interactive topic modeling and document clustering *Partitional Clustering Algorithms* (pp. 215-243): Springer.

Kumar, K. (2018) *How Successful Is Modi Government's Smart Cities Mission? /Interviewer: M. Natarajan*. Urban Reality.

Kumar, N. M., Goel, S., & Mallick, P. K. (2018). *Smart cities in India: Features, policies, current status, and challenges.* Paper presented at the 2018 Technologies for Smart-City Energy Security and Power (ICSESP).

Kumar, R. L. (2002). Managing risks in IT projects: an options perspective. *Information & management, 40*(1), 63-74.

Kumar, V. T. M., & Dahiya, B. (2017). Smart economy in smart cities *Smart Economy in Smart Cities* (pp. 3-76): Springer.

Kummitha, R. K. R. (2018). Entrepreneurial urbanism and technological panacea: Why Smart City planning needs to go beyond corporate visioning? *Technological Forecasting and Social Change, 137*, 330-339.

Kummitha, R. K. R., & Crutzen, N. (2019). Smart cities and the citizen-driven internet of things: A qualitative inquiry into an emerging smart city. *Technological Forecasting and Social Change, 140*, 44-53.

Lam, P. T. (1999). A sectoral review of risks associated with major infrastructure projects. *International Journal of Project Management, 17*(2), 77-87.

Lazaroiu, G. C., & Roscia, M. (2012). Definition methodology for the smart cities model. *Energy, 47*(1), 326-332.

Lee, S.-H., Yigitcanlar, T., Han, J.-H., & Leem, Y.-T. (2008). Ubiquitous urban infrastructure: Infrastructure planning and development in Korea. *Innovation, 10*(2-3), 282-292.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. California: Sage Publications.

Lovell, H. (2017). Are policy failures mobile? An investigation of the Advanced Metering Infrastructure Program in the State of Victoria, Australia. *Environment and Planning A: Economy and Space, 49*(2), 314-331.

Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. *AISHE-J: The All Ireland Journal of Teaching and Learning in Higher Education, 9*(3).

Mahizhnan, A. (1999). Smart Cities: The Singapore Case. *Cities, 16*(1), 13– 18.

Maier, S. (2016). Smart energy systems for smart city districts: case study Reininghaus District. *Energy, Sustainability and Society, 6*(1), 23.

Markowski, A. S., & Mannan, M. S. (2008). Fuzzy risk matrix. *Journal of hazardous materials, 159*(1), 152-157.

Martin, C. J., Evans, J., & Karvonen, A. (2018). Smart and sustainable? Five tensions in the visions and practices of the smart-sustainable city in Europe and North America. *Technological Forecasting and Social Change, 133*, 269-278.

McClellan, S., Jimenez, J. A., & Koutitas, G. (2017). *Smart cities: Applications, technologies, standards, and driving factors*: Springer.

Meier, A., & Portmann, E. (2017). *Smart City: Strategie, Governance und Projekte*: Springer-Verlag.

Meloche, J.-P., & Vaillancourt, F. (2015). Designing proper fiscal arrangements for sub-local decentralization in Montreal. *Journal of Urban Affairs, 37*(5), 530-547.

Milis, K., & Mercken, R. (2002). Success factors regarding the implementation of ICT investment projects. *International Journal of Production Economics, 80*(1), 105-117.

Ministry of Housing and Urban Affairs. (2018). *Details of funds released by Government of India to States/UTs for Smaft Cities till 31 March 20f8 under Smaft Cities Mission*. Retrieved from http://smartcities.gov.in/upload/uploadfiles/files/Fund%20released%20status%20till%2031%20March%202018.pdf

Ministry of Housing and Urban Affairs. (2019, 11-05-2019). Smart Cities Mission. *City Challenge*. Retrieved from http://smartcities.gov.in/content/city_challenge.php

Ministry of Housing and Urban Affairs, G. o. I. (2016). *The Smart City Challenge*. Retrieved from http://smartcities.gov.in/upload/uploadfiles/files/BHUBANESWAR_SCP.pdf

Ministry of Urban Development. (2015). *Smart City: Mission Statement and Guidelines*. Retrieved from Delhi, India: http://smartcities.gov.in/writereaddata/Process%20of%20Selection.pdf

Mishra, B. (2013). The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RFCTLARR Act) Comparative Presentation with LA Act 1894. *Rehabilitation and Resettlement Act*.

Monzon, A. (2015). *Smart cities concept and challenges: Bases for the assessment of smart city projects*. Paper presented at the 2015 international conference on smart cities and green ICT systems (SMARTGREENS).

Mooij, J. E. (2003). *Smart Governance?: Politics in the Policy Process in Andhra Pradesh, India*: Overseas Development Institute London.

Mora, L., & Deakin, M. (2019). *Untangling Smart Cities: From Utopian Dreams to Innovation Systems for a Technology-Enabled Urban Sustainability*: Elsevier.

Mora, L., Deakin, M., & Reid, A. (2017). *Smart-City Development Paths: Insights from the First Two Decades of Research*. Paper presented at the International conference on Smart and Sustainable Planning for Cities and Regions.

Mora, L., Deakin, M., & Reid, A. (2019). Strategic principles for smart city development: A multiple case study analysis of European best practices. *Technological Forecasting and Social Change, 142*, 70-97.

Myeong, S., Jung, Y., & Lee, E. (2018). A Study on Determinant Factors in Smart City Development: An Analytic Hierarchy Process Analysis. *Sustainability, 10*(8), 2606.

N. Komninos. (2011). Intelligent Cities: Variable Geometries of Spatial Intelligence. *Intelligent Buildings Inter-national, 3*(3), 172-188.

Nam, T., & Pardo, T. A. (2011). *Conceptualizing smart city with dimensions of technology, people, and institutions.* Paper presented at the Proceedings of the 12th annual international digital government research conference: digital government innovation in challenging times.

Naphade, M., Banavar, G., Harrison, C., Paraszczak, J., & Morris, R. (2011). Smarter cities and their innovation challenges. *Computer, 44*(6), 32-39.

Narain, V. (2009). Growing city, shrinking hinterland: land acquisition, transition and conflict in peri-urban Gurgaon, India. *Environment and Urbanization, 21*(2), 501-512.

Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in Smart City initiatives: Some stylised facts. *Cities, 38*, 25-36.

Nelson, K. M., Nadkarni, S., Narayanan, V., & Ghods, M. (2000). Understanding software operations support expertise: a revealed causal mapping approach. *Mis Quarterly*, 475-507.

Ness, D. (2007). Smart, sufficient and sustainable infrastructure systems. *Background paper*.

Nicholas, J. M., & Steyn, H. (2008). *Project management for business, engineering, and technology: Principles and practice*: Elsevier.

Odendaal, N. (2003). Information and communication technology and local governance: understanding the difference between cities in developed and emerging economies. *Computers, Environment and Urban Systems, 27*(6), 585-607.

Ojo, A., Curry, E., & Janowski, T. (2014). Designing next generation smart city initiatives-harnessing findings and lessons from a study of ten smart city programs.

Özdem, G. (2011). An Analysis of the Mission and Vision Statements on the Strategic Plans of Higher Education Institutions. *Educational Sciences: Theory and Practice*, 1887-1894. Retrieved from http://www.kuyeb.com/pdf/en/b6970ef3e88f91db4869e001b444d049emEN1.pdf

Pathak, C. (2016). Challenges of smart cities in India.

Pauca, V. P., Shahnaz, F., Berry, M. W., & Plemmons, R. J. (2004). *Text mining using non-negative matrix factorizations.* Paper presented at the Proceedings of the 2004 SIAM International Conference on Data Mining.

Pheng, L. S. (2018). Project Risk Management *Project Management for the Built Environment* (pp. 159-176): Springer.

Pieplow, B. (2012). Project Risk Management Handbook: A Scalable Approach. *Risk*.

Pierce, P., & Andersson, B. (2017). Challenges with smart cities initiatives–A municipal decision makers' perspective.

Press Trust of India. (2015). Government upgrades 29 cities, towns for HRA, transport allowance. *Daily News and Analysis*. Retrieved from

https://www.dnaindia.com/business/report-government-upgrades-29-cities-towns-for-hra-transport-allowance-2090594

Radhakrishnan, S., Erbis, S., Isaacs, J. A., & Kamarthi, S. (2017). Novel keyword co-occurrence network-based methods to foster systematic reviews of scientific literature. *PloS one*, *12*(3), e0172778.

Rana, N. P., Luthra, S., Mangla, S. K., Islam, R., Roderick, S., & Dwivedi, Y. K. (2019). Barriers to the development of smart cities in Indian context. *Information Systems Frontiers*, *21*(3), 503-525.

Renaud, B. (1987). *Urban development policies in developing countries.* Paper presented at the The Economics of Urbanization and Urban Policies in Developing Countries—a World Bank Symposium.

Riemenschneider, C. K., Armstrong, D. J., Allen, M. W., & Reid, M. F. (2006). Barriers facing women in the IT work force. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, *37*(4), 58-78.

Sahasranaman, A. (2012). Financing the development of small and medium cities. *Economic and Political Weekly*, *47*(24), 59-66.

Saldanha, A. (Producer). (2018). Budget 2018: Promises of smart cities, employment and housing displaying little progress in India. *Busness News*.

Sankhe, S., Vittal, I., Dobbs, R., Mohan, A., & Gulati, A. (2010). India's urban awakening: Building inclusive cities sustaining economic growth.

Shapiro, J. M. (2008). Smart cities: quality of life, productivity, and the growth effects of human capital. *Review of Economics and Statistics*, *88*, 324-335.

Shelton, T., Zook, M., & Wiig, A. (2015). The 'actually existing smart city'. *Cambridge Journal of Regions, Economy and Society*, *8*(1), 13-25.

Shenhar, A. J., & Dvir, D. (2007). *Reinventing project management: the diamond approach to successful growth and innovation*: Harvard Business Review Press.

Simon, P. (1997). PRAM Project Risk Analysis and Management Guide-Association for Project Management. *High Wycombe, UK*.

Smart Cities Council. (2015). *Smart Cities Readiness Guide*. Retrieved from http://smartcitiescouncil.com/smart-cities-information-center/definitions-and-overviews

Smart Cities Mission. (2015). Kakinada. *Indian Smart City Profile-Kakinada*. Retrieved from http://smartcities.gov.in/upload/uploadfiles/files/AndraPradesh_Kakinada.pdf

Smart Cities World. (2018). Understanding the Challenges and Opportunities of Smart Cities. *in association with Philips*. Retrieved from https://smartcitiesworld.net/AcuCustom/Sitename/DAM/012/Understanding_the_Challenges_and_Opportunities_of_Smart_Citi.pdf

Smith, R. M., Pathak, P. A., & Agrawal, G. (2019). India's "smart" cities mission: A preliminary examination into India's newest urban development policy. *Journal of Urban Affairs, 41*(4), 518-534.

Söderström, O., Paasche, T., & Klauser, F. (2014). Smart cities as corporate storytelling. *City, 18*(3), 307-320.

Sotoni, A., Qefalia, A., & Barolli, E. Risks in large scale projects management: Case of industrial parks development in Albania. *KONFERENCA E KATËRT*, 105.

Taylor Buck, N., & While, A. (2017). Competitive urbanism and the limits to smart city innovation: The UK Future Cities initiative. *Urban Studies, 54*(2), 501-519.

Techatassanasoontorn, A. A., & Suo, S. (2010). *Exploring Risks in Smart City Infrastructure Projects: Municipal Broadband Initiatives.* Paper presented at the PACIS.

Torres, L., Pina, V., & Acerete, B. (2005). E-government developments on delivering public services among EU. *Cities, 22*, 217-238.

Tyas, W., Nugroho, P., Sariffuddin, S., Purba, N., Riswandha, Y., & Sitorus, G. (2019). *Applying Smart Economy of Smart Cities in Developing World: Learnt from Indonesia's Home Based Enterprises.* Paper presented at the IOP Conference Series: Earth and Environmental Science.

United Nations, D. o. E. a. S. A. (2016). Population Division (2016). The World's Cities in 2016 – Data Booklet (ST/ESA/ SER.A/392).

Vadgama, C., Khutwad, A., Damle, M., & Patil, S. (2015). Smart funding options for developing smart cities: A proposal for India. *Indian Journal of Science and Technology, 8*(34), 1-12.

Vaidya, C. (2009). *Urban Issues, Reforms, and Way Forward in India*: Department of Economic Affairs, Ministry of Finance.

Valdez, A.-M., Cook, M., & Potter, S. (2018). Roadmaps to utopia: Tales of the smart city. *Urban Studies, 55*(15), 3385-3403.

Van den Bergh, J., & Viaene, S. (2015). *Key challenges for the smart city: Turning ambition into reality.* Paper presented at the System Sciences (HICSS), 2015 48th Hawaii International Conference on.

Van Heerden, J. P. (2013). *Reducing risks in large scale projects: investigating the integration of systems engineering principles into project management.* Stellenbosch: Stellenbosch University.

Vidyarthi, S. (2004). 74 th Constitution Amendment Act and Present Economic Growth as Catalyzing Agent for Urban Development. *ITPI Journal, 1*(3), 65-69.

Walewski, J., Gibson, G., & Vines, E. (2002). *Improving international capital project risk analysis and management.* Paper presented at the Proceedings of Project Management Institute Research Conference.

Wenge, R., Zhang, X., Dave, C., Chao, L., & Hao, S. (2014). Smart city architecture: A technology guide for implementation and design challenges. *China Communications, 11*(3), 56-69.

Wolfram, M. (2012). *Deconstructing smart cities: an intertextual reading of concepts and practices for integrated urban and ICT development*: na.

Xu, W., Liu, X., & Gong, Y. (2003). *Document clustering based on non-negative matrix factorization.* Paper presented at the Proceedings of the 26th annual international ACM SIGIR conference on Research and development in informaion retrieval.

Yalegama, S., Chileshe, N., & Ma, T. (2016). Critical success factors for community-driven development projects: A Sri Lankan community perspective. *International Journal of Project Management, 34*(4), 643-659.

Yamin, M., & Sim, A. K. (2016). Critical success factors for international development projects in Maldives: Project teams' perspective. *International Journal of Managing Projects in Business, 9*(3), 481-504.

Yigitcanlar, T. (2015). Smart cities: an effective urban development and management model? *Australian Planner, 52*(1), 27-34.

Yigitcanlar, T., Kamruzzaman, M., Buys, L., Ioppolo, G., Sabatini-Marques, J., da Costa, E. M., & Yun, J. J. (2018). Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework. *Cities, 81*, 145-160.

Yigitcanlar, T., & Lee, S. H. (2014). Korean ubiquitous-eco-city: A smart-sustainable urban form or a branding hoax? *Technological Forecasting and Social Change, 89*, 100-114.

Yoshikawa, Y., Sato, A., Hirasawa, S., Takahashi, M., & Yamamoto, M. (2012). Hitachi's vision of the smart city. *Hitachi Review, 61*(3), 111-118.

Yovanof, G. S., & Hazapis, G. N. (2009). An architectural framework and enabling wireless technologies for digital cities & intelligent urban environments. *Wireless Pers. Communication, 49*, 445–463.

Zanella, A., Bui, N., Castellani, A., Vangelista, L., & Zorzi, M. (2014). Internet of things for smart cities. *IEEE Internet of Things journal, 1*(1), 22-32.

Zou, P. X., Zhang, G., & Wang, J. (2007). Understanding the key risks in construction projects in China. *International Journal of Project Management, 25*(6), 601-614.

Annexure 1: Additional Data and Methods for Chapter 2

15. RISKS

What are the three greatest risks that could prevent the success of the area-based proposal? In Table 2, describe each risk, its likelihood, the likely impact and the mitigation you propose. (max. 50 words per cell)

TABLE 2

Risk	Likelihood	Impact	Mitigation
WILLINGNESS TO PARTICIPATE: Smart City Mission proposes to bring disruptive change in "Business as usual" scenario. BTCD proposals like slum redevelopment, street vendor improvement programme will require willing participation from citizens. Secondly, digital divide can become a major barrier in achieving inclusivity in governance and delivery of public services.	Low to Moderate: (i) 56% of population lives in informal settlements (ii) Two major projects of Satya Nagar Institutional Core and Janpath Government Housing Redevelopment dependent upon shifting of government housing and offices	Moderate: (i) Less usability and uptake of services will decrease the impact of public investments proposed in BTCD. (ii) Resistance to temporary relocation to transit houses can delay slum redevelopment project.	Address with Prevention and move on to Accept with Strategy, if required: (i) Successful Participatory planning process has decreased the risks. (ii) Proposal allocates 1% of budget for robust citizen engagement programme for continued social mobilization during implementation. (iii) Digital Literacy Programme and PIAC project to bridge digital divide.
CAPACITY CONSTRAINTS: Implementation of SCP will require skills that are not available across various government agencies. Secondly, it will constantly require research and formulation of strategies to deal with day to day challenges. Thirdly, to document and share the process of implementation for course correction and future reference.	Moderate: (i) No major investments and recruitments in past decade (ii) Lack of flexibility and authority to engage domain experts (iii) Constraint to attract talent as compensation are not market driven	Moderate to Significant: (i) Significant impact on kick off activities for want of any institutional memory (ii) Significant Impact on monitoring technology deployment for want of standards which can lead to vendor capture (iii) Moderate Impact on infrastructure improvement and utility operation	Allocate (i) SCP proposes to establish Bhubaneswar Urban Knowledge Centre in partnership with Xavier's University, Bhubaneswar for providing one stop solution to capacity constraints. (ii) Technical Assistance Programmes with international development agencies like DFID, IFC & GIZ can help in overcoming these constraints. (iii) Appointment of Project Management Consultants

Figure 16: Risk Table Snapshot from a SCP.

Table 10: Initial Codes Generated for Risk Classification

Final Codes	Social	Institutional	Partnership and Resource Management	Financial	Scheduling and Execution	Environment	Technology	Political
Initial Codes	Citizen_participation	Inter-Agency_coordination	Physical_infrastructure	Funds_availability	Non-maintenance	Disaster_management	Privacy	Political_apathy
	Resistance_stakeholders	Technical_capacity	public_infratructure	Financial_sustainability	project_complexity	environment_degradation	Data_security	Political_will
	Citizen_participation	system_functioning	Resource_availability	Funding_delay	Scale	Multi-hazard_vulnerability	Interoperability	Local_political_opposition
	Citizen_behavior	incompetent_governance	Private-partner	Funding_shortage	Integration_physical	Drought	Digital_solution_implementation	Political
	Change_management	Organizational_capacity	Market_availability	convergence_state/central_schemes	service_delivery	Flooding	Technology_resistance	
	Citizen_awareness	Improper_management	Quality_control	Funding_Reduction	Operationalization	Construction_pollution	equipment_import	
	Resistance_reforms	corrupt_satff	Vendor_selection	Cost_escalation	Integration_multimode_transportation		Technology_availability	
	Tampering_instrument	Skill-gap	Procurement	Poor_financial_plan	project_size		Data sharing policy	
	non-payment	Multiple_horizontal/vertical_integration	Reliability_Technology_partners/suppliers	Improper_Convergence	Timebound_implementation		Untesteted_technology_response	
	user_charges	City-state_coordination	Land_availability	Financial	Completion_delay		Digital_divide	

Final Codes	Social	Institutional	Partnership and Resource Management	Financial	Scheduling and Execution	Environment	Technology	Political
	Encroachment	Capacity_constraints	Land_possession_delay		inability_implement_usercharges			
	citizen_discontent	Policy_Conflicts	Resistance_industries/businesses		Execution			
	Citizen_adoption	Lack_structured_institutional_framework	PPP_resources		Installation			
	Social	Legal	Poor_utility_network					
	Inequality	Approval_delay	Labor_unavailability					
	Citizen_ownership	Regulations_complex						

To analyze the SCPs, in step 1, topic modeling was used that resulted in the identification of five categories, namely, Execution, Social, Institutional, Financial, and Environmental.

In Step 2, semantic analysis was performed that resulted in the identification of 11 categories, including: Technology, Social, Institutional, Financial, Integration with other schemes, Environmental, Disaster-prone, Execution, Resources, Stakeholders, and Political.

In Step 3, based on the similar nature of the risks discussed, Financial and Integration with other schemes; Environmental and Disaster-prone; and Resources and Stakeholders were combined as shown in Table 10. Table 10 provides a brief description of the initial codes generated in the process of semantic analysis and later collapsed into the final eight codes/risk categories.

Annexure 2: Additional Data and Methods for Chapter 3

Table 11: Detailed explanation of phrases used for identifying risk categories

Interviewee	Rank	Risk A	Explanation (summarized phrases)	Risk B	Explanation (summarized phrases)
IP-1	1	R&P	Local contractors	F	Budget Constraint
IP-1	2	I	Lack of experience with engineers/officials (constrained in their vision/thinking)		
IP-1	3	I	Approval challenges (obtaining NOCs)		
IP-1	4	E	Data collection issues		
IP-1	5	E	Enforcement challenges		
IP-1	6	S	Citizen resistance to use/participate in implementing mission		
IP-1	7	P	Political pressure (although not much)		
IP-2	1	E	Haste in delivering projects	P	Political Pressure/Performance Pressure
IP-2	2	E	In execution, division of work is still fragmented. For example, a beautification task is handled by one company and design/execution by another		
IP-3	1	I	Administrative challenges (city level): business as usual approach of implementing projects		
IP-3	2	F	Delay in releasing funds/payments of contractors	I	Delay in approval due to a business as usual approach, especially in convergence projects
IP-3	3	I	Lack of experience with engineers/officials (constrained in their vision/thinking)		
IP-4	1	S	Citizen resistance to use/participate in implementing mission		
IP-4	2	I	Local government officials overburdened with responsibilities (forming an SPV is not a solution unless an adequate number of qualified professionals are hired)		

Interviewee	Rank	Risk A	Explanation (summarized phrases)	Risk B	Explanation (summarized phrases)
IP-4	3	P	Passive state government		
IP-4	4	P	Political leaders adamant in leading decision making regarding project implementation		
IP-4	5	F	Designing projects which may not be financially feasible and may include a number of amendments	S	Resistance of communities to demolish a religious place, etc.
IP-5	1	P	Political will is a pre-requisite for implementing projects		
IP-5	2	R&P	Working with multiple stakeholders is difficult		
IP-5	3	T	Tech vendors are reluctant in working with cities with smaller population		
IP-6	1	T	Issue of data privacy, no policies for data sharing	I	Weak local government capacity to handle data privacy issue
IP-6	2	E	Slow pace of execution	R&P	Cross consideration of multiple stakeholders
IP-6	3	R&P	Lack of involvement of start-ups (presence of start-ups in the local area can solve city issues with a better understanding and flexibility than bigger consulting firms)		
IP-7	1	R&P	Private players are not interested to participate/pool funds as they do not trust city governments and previous bad experiences working with them	I	Business as usual approach of several city departments makes it difficult for private players to work with them
IP-7	2	R&P	Private players do not want to participate/pool funds as they do not trust city governments and previous bad experiences working with them	F	Delay in providing payments and sanctioning funds
IP-7	3	S	Citizen participation is almost zero, citizens want to live in a smart city but do not want to lend a hand in creating one		
KKD-1	1	P	Political buy-in is a prerequisite		
KKD-1	2	S	lack of smart citizens		
KKD-2	1	S	People are not cooperating as they are unhappy with development focused in one area		
KKD-2	2	E	Slower pace of project implementation	I	No fix tenure of CEOs is a major drawback, frequent transfers of CEOs leads to delay in project delivery

Interviewee	Rank	Risk A	Explanation (summarized phrases)	Risk B	Explanation (summarized phrases)
KKD-2	3	I	Man-power challenges (need more officials who are knowledgeable in project implementation)		
KKD-3	1	E	Lack of planning of projects (a lot of time is dedicated in revising the planned project and sequencing of projects)		
KKD-3	2	R&P	On-boarding of major players plagues the implementation, slowing down the pace as bidding process gets delayed		
KKD-4	1	S	Lack of participation of citizens as they are unaware of smart projects being implemented because of poor communication/advertising of these projects		
KKD-4	2	R&P	Big players hesitant to come to smaller cities such as Kakinada (weak connectivity to bigger cities, nearest airport being 1.5 hours away)		
KKD-4	3	R&P	Local contractors are hesitant to bid for projects	T	Local contractors lack professionals having knowledge to implement technology-based projects
KKD-5	1	S	Uninformed citizens further add challenges in implementing projects – need more responsible citizens for better participation		
KKD-5	2	R&P	Improper installations (poor quality of instruments deployed or poor material used)		
KKD-5	3	E	Takes longer than estimated in implementing a project due to non-cooperation of citizens especially in the ABD area	S	Impatience in citizens living/moving across project sites
KKD-5	4	I	lack of staff to ensure proper execution (overburdened city officials)		
KKD-6		No major challenges	Praised the mission		
KKD-7	1	E	Haste in executing projects to meet deadline leading to not so good quality of work	P	Pressure from mission directors and officials at the state level, competing with peer cities delivering smart projects
KNP-1	1	I	Integration of various departments (getting approvals and NOCs)		
KNP-1	2	P	Political interference in selection of ABD area (not much say)		
KNP-1	3	E	Enforcement of sanctioned projects, for example acquisition of land is very difficult and time consuming	R&P	Acquisition of land is time consuming

Interviewee	Rank	Risk A	Explanation (summarized phrases)	Risk B	Explanation (summarized phrases)
KNP-1	4	R&P	Acquisition of land is time consuming	S	Agreement with landowners on compensation and in some cases eviction of encroachment on the public land
KNP-1	5	S	Citizen resistance in abiding by the newly formulated rules/regulations, for example pedestrianization of Naveen market	E	Improper enforcement by police officials
KNP-2	1	S	Encroachments on road by street vendors and slum dwellers/informal settlements	E	Enforcement challenges
KNP-2	2	R&P	Bidding and tendering get delayed as no contractors apply	R&P	Contractors not well-versed with the concept of Smart City
KNP-2	3	R&P	Contractors not well-versed with the concept of Smart City	T	Lack of technical know-how
KNP-2	4	I	Business as usual approach of several local departments in granting approvals and providing NOCs especially in convergence projects		
KNP-3		No major challenges	City municipality has control on everything		
KNP-4		No major challenges	City officials are handling the projects very well		
KNP-5	1	T	Lack of technical vendors bidding for the project		
KNP-5	2	I	Communication across departments for approvals and NOCs is a time-consuming process		
KNP-5	3	R&P	Availability of land for project development		
KNP-6	1	R&P	Lack of bidders for the RFPs floated	T	Lack of technical knowhow amongst contractors
KNP-6	2	R&P	Lack of bidders for the RFPs floated	R&P	Distrust amongst private players to work with city governments
KNP-6	3	R&P	Distrust amongst private players to work with city governments	F	Delay in providing payments
KNP-6	4	I	City officials want to implement projects but are not well-versed with technological advancements		

Table 12: Risk Co-occurrences

Risk A	Risk B	Occurrence	Adjacency matrix (Values)		Source	Target	Edges
Execut	Pol	2	0.100	10%	Pol	Exe	2
Execut	Soc	1	0.050	5%	Soc	Exe	1
Execut	Inst	1	0.050	5%	Inst	Exe	1
Execut	Res	2	0.100	10%	Res	Exe	2
Fin	Inst	1	0.050	5%	Inst	Fin	1
Res &Part	Tech	3	0.150	15%	Tech	Res	3
Res &Part	Fin	3	0.150	15%	Fin	Res	3
Res &Part	Inst	1	0.050	5%	Inst	Res	1
Soc	Exe	2	0.100	10%	Exe	Soc	2
Tech	Insti	1	0.050	5%	Inst	Tech	1
Res &Part	Soc	1	0.050	5%	Soc	Res	1
Res &Part	Res &Part	2	0.100	10%	Res	Res	2
Total co-occurrences:		**20**					

Annexure 3: Additional Data and Methods for Chapter 4

Table 13: Analysis of comments on Smart Cities Mission and Special Purpose Vehicles

Professional type	Overall Comments on Smart Cities Mission	Positive	Negative	SPV	Defining Smartness	Is it important to become smart?	Why
IP-1	A step towards "integrating the various city development missions" to "develop a city holistically"	"Integrated + Comprehensive"	"Lacks project management" because of "capacity issues"	"SPV formation" is surely a "good step" to establish "coordination between various agencies and in managing funds"	Smartness is a gradual process starting with provision of infrastructure, for instance, smart road for Indian cities is about building a road which can be accessed by one and all. This is a first step and should aim at building a strong foundation for becoming smart		
IP-2	"A good initiative which lacks the bigger picture", to do that strategies need to be planned such that "flow of infrastructure is streamlined"	"began a positive conversation between cities, academia, industrial professionals"	SCM may not be the correct term but this mission is important to restructure the existing urban services	"Fragmented implementation"	SCM is important for integrated development of the city and to do that strategies need to be planned such that flow of infrastructure is streamlined.		
IP-3	This is "an initiative to generate new ideas, and to compel the local municipalities to think of out of the box solutions"	Making the cities compete is a good idea	Though this mission is putting a lot of pressure on the local government but is pushing the limits of the				

Professional type	Overall Comments on Smart Cities Mission	Positive	Negative	SPV	Defining Smartness	Is it important to become smart?	Why
			local government employees. GoI was not ready and "rolled out the mission in haste"				
IP-4	SCM being a dream project of the PM, Central and State ministry is rigorously following up each project	Selection of city (competitive), delivering project outputs in a time bound manner					
IP-5	Dedicated funds are available, better monitoring of funds disposal, result in quality projects being delivered as SCM involves PMCs for design, tendering assistance, etc.	Comprehensiveness of the mission is its USP as SCM has a lot of breadth			To focus on "citizen's convenience" is prime and basic need infrastructure for commuting, roads, water, electric supply and waste management, Apart from that beautification of city and promoting tourism in the city Thus most projects being implemented or planned to be implemented are based on "provision of basic infrastructure to the citizens" There are very "few smart components" attached to it		

Professional type	Overall Comments on Smart Cities Mission	Positive	Negative	SPV	Defining Smartness	Is it important to become smart?	Why
IP-6	We don't have a choice other than going the smart way	Will help cities to organize and coordinate at city level					
IP-7	First step aimed at building a strong foundation for becoming smart	"timely", "making citizen engagement essential"	Lot of flaws in the mission, should have "focused on 20 proposed SCs" to become model for other proposed cities				
KKD-1	"A very good concept which fails to provide a framework to implement the mission"		"The biggest challenge with the mission is that there is no definition of a smart city which should have been the first thing to do in the mission" mission	Best outcome of SCM has led to improved working and implementation of project	"streamlining infrastructure development" and "connecting the urban services"	Y	improving public convenience increase tourism
KKD-2	SCM has a lot of breadth in terms of type of projects being implemented	"a step towards comprehensiveness, unlike previous missions"			Smart cities for Indian cities mean "using data to integrate services" and attain quick service delivery and provide quick response to day to day citizens' complaints/queries	Y	building transparency
KKD-3	A good initiative needs support from one and all		Mission is "too broad", no specific			N	smartness for Kakinada means access to

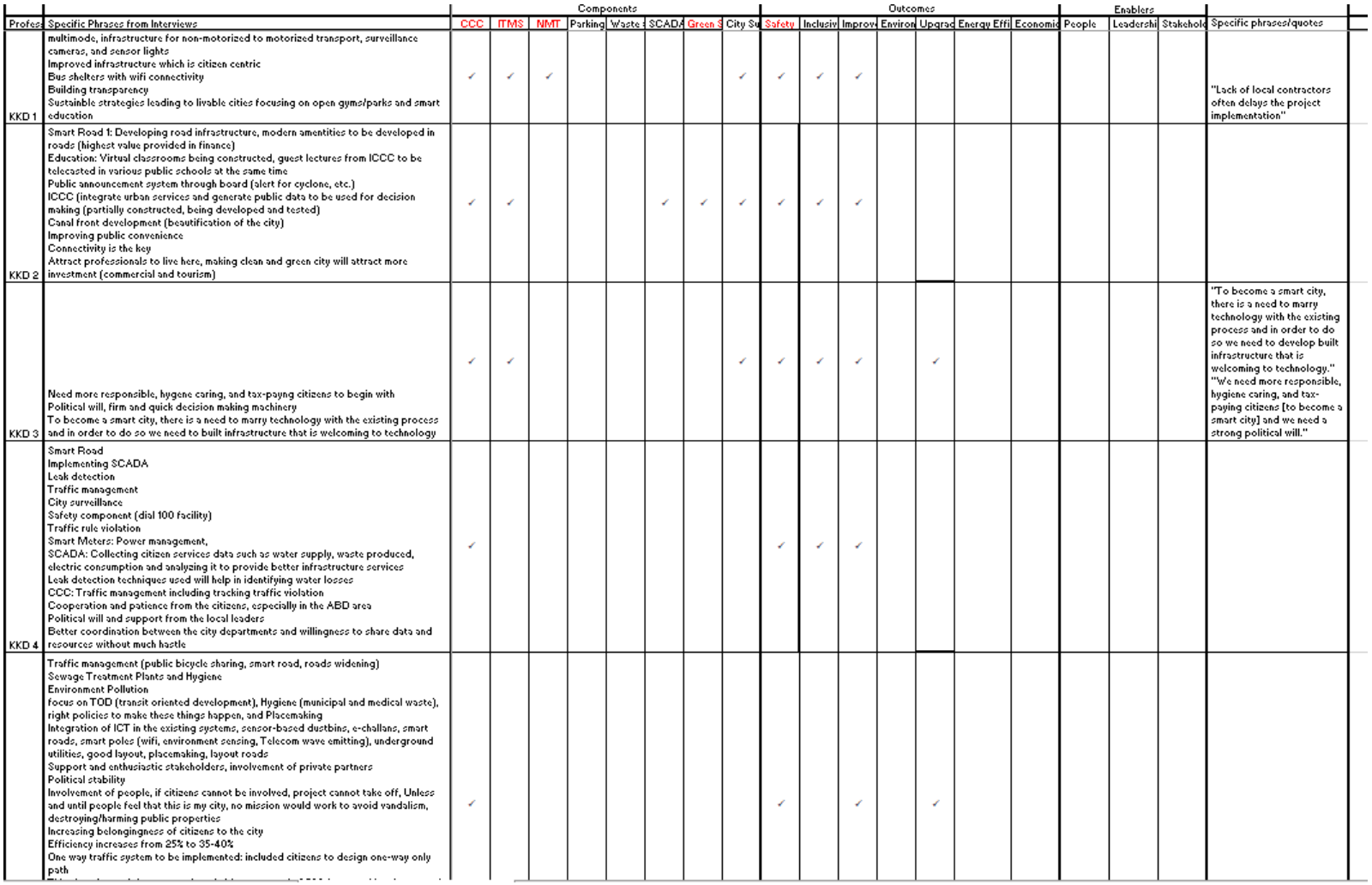
Professional type	Overall Comments on Smart Cities Mission	Positive	Negative	SPV	Defining Smartness	Is it important to become smart?	Why
			deliverables				all
KKD-4	Creating positive energy amongst cities, SCM has provided a push to infrastructure development in the city					Y	improved quality of life, better roads, no power outages
KKD-5	Has "holistic" approach although should have been tested before					Y	improved living, cleaner environment
KKD-6	Conscious efforts to improve the city infrastructure, not focused only on bigger cities					Y	access to city services to more citizens
KKD-7	A positive effort by Central Govt in infrastructure building, lacks efforts by state government					Y	livable cities
KNP-1	Holistic department not project based, we are working on all the areas	Focuses on urban redevelopment strategies by providing basic infrastructure, organization and utilization of urban spaces and then make them smart			using data driven strategies in planning urban services	Y	improving transparency

Professional type	Overall Comments on Smart Cities Mission	Positive	Negative	SPV	Defining Smartness	Is it important to become smart?	Why
KNP-2	SCM is not project based mission it is driven by idea/thought process					Y	city's focus is on making streets safer for one and all under smart city mission activities
KNP-3	New way to respond to the existing urban issues in the cities				by focusing on improving the physical infrastructure and strengthening local institutional mechanism	Y	safety of citizens in all places, on road, at home, and work places
KNP-4	Mission is a response towards rapid urbanization					Y	greener, cleaner, and a city where people care for each other
KNP-5	"Multi-stakeholder, multi-finance project" which requires convergence					Y	safety and environmental sustainability
KNP-6	"mission with a vision", integrates other missions					Y	"a step to integrate the various urban missions", "important for holistic development of a city", and "will bring in more tourists

Professional type	Overall Comments on Smart Cities Mission	Positive	Negative	SPV	Defining Smartness	Is it important to become smart?	Why
							and businesses".

		Components								Outcomes							Enablers			
Profes	Specific Phrases from Interviews	CCC	ITMS	NMT	Parking	Waste	SCADA	Green S	City Su	Safety	Inclusiv	Improv	Environ	Upgrad	Energy Effi	Economic	People	Leadershi	Stakehold	Specific phrases/quotes
IP 1	Focusing on NMT infrastructure (up till now most most projects were planned for motorized transport); Focuses on Urban redevelopemnt startegies by providing basic infrastructure, organization and utilization of urban spaces and then make them smart; Parking management is needed, as there are lack of parking areas, and enforcement system not in place; Maintenance of heritage in cities To become organized and coordinated.	✓	✓	✓	✓				✓	✓	✓			✓						"better coordination between the city departments and willingness to share data and resources across departments should be the first step"
IP 2	Sewage/ waste water management Improve the urban design of the city to make the streets more usable and accessible Smartness in India, include making streets safer by improving pedestrian movement by creating footpaths wherever required Storm water management Creating reusable public spaces Provising NMT infrastructure Easing public access to urban services and identifying ways to make these services better restructure the existing urban services Healthier, safer cities	✓	✓	✓		✓				✓	✓			✓						"firm and quick decision making machinery can implement SC projects at a much faster rate."
IP 3	Traffic Storm water management	✓																		"stakeholder collaboration is important but this will require time as it involves building trust and should not be done in haste".
IP 4	Waste management	✓				✓														
IP 5	Smart Road Implementing SCADA Leak detection Traffic management City surveillance Safety component (dial 100 facility) Traffic rule violation Smart Meters: Power management, SCADA: Collecting citizen services data such as water supply, waste produced, electric consumption and analyzing it to provide better infrastructure services Leak detection techniques used will help in identifying water losses CCC: Traffic management including tracking traffic violation Cooperation and patience from the citizens, especially in the ABD area Political will and support from the local leaders Better coordination between the city departments and willingness to share data and resources without much hastle	✓	✓				✓		✓	✓		✓		✓			Citizens and Leadership			
IP 6	Traffic management (public bicycle sharing, smart road, roads widening) Sewage Treatment Plants and Hygiene Environment Pollution focus on TOD (transit oriented development), Hygiene (municipal and medical waste), right policies to make these things happen, and Placemaking Integration of ICT in the existing systems, sensor-based dustbins, e-challans, smart roads, smart poles (wifi, environment sensing, Telecom wave emitting), underground utilities, good layout, placemaking, layout roads Support and enthusiastic stakeholders, involvement of private partners Political stability Involvement of people, if citizens cannot be involved, project cannot take off, Unless and until people feel that this is my city, no mission would work to avoid vandalism, destroying/harming public properties Increasing belongingness of citizens to the city Efficiency increases from 25% to 35-40% One way traffic system to be implemented: included citizens to design one-way only path This also changed the perspective of citizens towards SCM, increased involvement of 60+ NGOs 18 ideas chosen from a pool of more than 6000 ideas (brainstormed by youth of Kanpur), Citizen-centric Using SCADA for utilities such as water and wastewater management, getting hold of data to make informed decisions	✓		✓		✓					✓						Citizens, Provate Partners, and Leadership			

			Components								Outcomes							Enablers			
	Profes	Specific Phrases from Interviews	CCC	ITMS	NMT	Parking	Waste	SCADA	Green S	City Su	Safety	Inclusiv	Improv	Environ	Upgrad	Energy Effi	Economic	People	Leadershi	Stakehold	Specific phrases/quotes
5	KNP 1	such as footpaths, green dividers and, street infrastructure, utility ducting so that no overhead cables should no longer be seen in the ABD area (to begin with) as the roads in the ABD area are wider than the roads in other parts of the city Solid waste: eight automatic solid waste management stations are built, krishna nagar sudhar ghar kidwai nagar, chunni ganj janta nagar police chowki, panki kalyanpur. ICT based monitoring of solid waste management, CCC: 8 comnponents- Smart city operation center, common city services, smart city management portal (system integrator), air and water monitoring, city surveillance, wifi availability in hospitals, bus and railway stations E-common services-online grievance redressal system City surveillance: e-challans, traffic management, ITMS regulations, issue in implementing e-challans. Digital message boards displaying air quality Open gyms in 6 parks such as nanarao, ramleela, kargil park, etc. 1 crore invested in all Focus in Kanpur: we want to add smartness by adding a technology layer to the existing infrastructure and improve the capacity building of the officials at local governance level Projects being implemented in a holistic manner Operation of SC is being done by the SPV (under chairmanship of divisional chairman) We want to build the ABD area such that the citizens residing in other areas should	✓	✓			✓	✓	✓	✓	✓		✓				✓				
3	KNP 2	Smart parking (riders can punch by themselves), integrating parking lots to the municiplaity/contrcator to account for revenue generation Indoor stadium building in brijendra swaroop park (low profit margin 70:30 pvt : gov) Revenue generation Our focus on planning and implementing projects is to make the all the urban services connected/integrated With fast moving world, the pace of liflife of the people is run To account for energy losses, we are applying SCADA make Kanpur healthier: waste disposal system, applying rfid tags on individual housing ICCC: Tech Mahindra Tech Mahindra: ICCC, 330 cr project (smart parking solution, city surveillance, ecss urban services such as birth certificate, etc), wifi urban services-integrated city surveilliance Health and safety, cleanliness of a city Accountability will increase Employment generation will take place	✓	✓		✓				✓	✓		✓								
7	KNP 3	Focusing on NMT infrastructure (up till now most most projects were planned for motorized transport); Focuses on Urban redevelopemnt startegies by providing basic infrastructure, organization and utilization of urban spaces and then make them smart; Parking management is needed, as there are lack of parking areas, and enforcement system not in place; Maintenance of heritage in cities To become organized and coordinated.	✓	✓				✓		✓	✓		✓								city-level agencies have to come together to implement the mission activities in an organized fashion
8	KNP 4	Increasing the road width of the core city Sewage/ waste water management Improve the urban design of the city to make the streets more usable and accessible Smartness in India, include making streets safer by improving pedestrian movement by creating footpaths wherever required Storm water management Creating reusable public spaces Provising NMT infrastructure Easing public access to urban services and identifying ways to make these services better restructure the existing urban services Healthier, safer cities	✓							✓	✓		✓								
9	KNP 5	Parking management is needed, as there are lack of parking areas, and enforcement system not in place; Maintenance of heritage in cities To become organized and coordinated	✓								✓		✓		✓						



		Components								Outcomes							Enablers				
Profes	Specific Phrases from Interviews	CCC	ITMS	NMT	Parking	Waste	SCADA	Green S	City Su	Safety	Inclusiv	Improv	Environ	Upgrad	Energy Effi	Economic	People	Leadershi	Stakehol	Specific phrases/quotes
KKD 1	multimode, infrastructure for non-motorized to motorized transport, surveillance cameras, and sensor lights Improved infrastructure which is citizen centric Bus shelters with wifi connectivity Building transparency Sustainble strategies leading to livable cities focusing on open gyms/parks and smart education	✓	✓	✓					✓	✓	✓	✓								"Lack of local contractors often delays the project implementation"
KKD 2	Smart Road 1: Developing road infrastructure, modern amentities to be developed in roads (highest value provided in finance) Education: Virtual classrooms being constructed, guest lectures from ICCC to be telecasted in various public schools at the same time Public announcement system through board (alert for cyclone, etc.) ICCC (integrate urban services and generate public data to be used for decision making (partially constructed, being developed and tested) Canal front development (beautification of the city) Improving public convenience Connectivity is the key Attract professionals to live here, making clean and green city will attract more investment (commercial and tourism)	✓	✓				✓	✓	✓	✓	✓	✓								
KKD 3	Need more responsible, hygene caring, and tax-payng citizens to begin with Political will, firm and quick decision making machinery To become a smart city, there is a need to marry technology with the existing process and in order to do so we need to built infrastructure that is welcoming to technology	✓	✓						✓	✓	✓	✓		✓						"To become a smart city, there is a need to marry technology with the existing process and in order to do so we need to develop built infrastructure that is welcoming to technology." "We need more responsible, hygiene caring, and tax-paying citizens [to become a smart city] and we need a strong political will."
KKD 4	Smart Road Implementing SCADA Leak detection Traffic management City surveillance Safety component (dial 100 facility) Traffic rule violation Smart Meters: Power management, SCADA: Collecting citizen services data such as water supply, waste produced, electric consumption and analyzing it to provide better infrastructure services Leak detection techniques used will help in identifying water losses CCC: Traffic management including tracking traffic violation Cooperation and patience from the citizens, especially in the ABD area Political will and support from the local leaders Better coordination between the city departments and willingness to share data and resources without much hastle	✓								✓	✓	✓								
	Traffic management (public bicycle sharing, smart road, roads widening) Sewage Treatment Plants and Hygiene Environment Pollution focus on TOD (transit oriented development), Hygiene (municipal and medical waste), right policies to make these things happen, and Placemaking Integration of ICT in the existing systems, sensor-based dustbins, e-challans, smart roads, smart poles (wifi, environment sensing, Telecom wave emitting), underground utilities, good layout, placemaking, layout roads Support and enthusiastic stakeholders, involvement of private partners Political stability Involvement of people, if citizens cannot be involved, project cannot take off, Unless and until people feel that this is my city, no mission would work to avoid vandalism, destroying/harming public properties Increasing belongingness of citizens to the city Efficiency increases from 25% to 35-40% One way traffic system to be implemented: included citizens to design one-way only path	✓								✓		✓		✓						

Figure 17: Snapshot of data analysis of Components, Outcomes, and Enablers

Table 14: Summary from News reports on Mission Progress and Status to triangulate data from Interviews

Report Name	Summary from report	Risk	Date
The ground reality of Smart City Mission-Lallantop	Projects include: -facade improvement of building in the city core to keep the older look -citizen's not receptive of this idea and needs proof before they sign NOCs to have their building's facade improve -citizens were not really asked/involved -Anand Menon, Darashaw (Consultancy) -ICCC is planned, which will view traffic intersections and improve city's safety	S	18-Apr-19
Smart City Projects: Challenges For India | India Risk Report, ET Now,	Two SC experts -Mujeeb ul Rehman, Team Leader, Ujjain SC Focus – ease of life covering basic services, small pockets were selected to develop as a model to implement Developing major roads into smart roads (including ITS, all **utilities will be underground**) Anchor-Typical bureaucratic delays, No-city level committees are formed to select SC projects Lack of trust of private companies in municipalities and lack of communication between people and potential investors ABD- Selected areas which are usually the city's core or business district and is a good model -Dr. Sudhir Krishna, Former Secretary of MOUD Concept picked up from the west SCM is timely as cities do need to become smart Smartness for Indian cities mean better quality of life, efficient service delivery system and safe environments require modern technology and investment in infrastructure but above all, we need institutional arrangement (where we did not meet the requirement) as municipalities do not rise to the occasion as they felt left out in planning the mission activities Is SC for the wealthier section of the society (question from anchor)? We need to develop a new framework for making SCM work. We need to work on the whole city rather working on a smaller patch (as ABD implementation has mixed responses), still project based and investment-driven implementation need to go ward level 5 items to be considered in a SC: 24*7 water and electric supply, good walkways and cycleways, Slum-free city (housing for all), and spruce water bodies in and around cities Anchor (2lac plus crores but less than 2% funds have been utilized), I don't see much benefit of selecting cities in several rounds.	I, S, S&E, R&P	10-Jul-18

Report Name	Summary from report	Risk	Date
	Anchor-Cities Ajmer, Ahmedabad and Varanasi is lagging behind from their contemporaries in Africa and Latin America. No foreign funding: Ans: Municipal accounts are not updated and hence the cities are unable to use municipal bonds to their use Absence of resilience-Anchor: How to sustain the plans in the longer run: The long term vision in the SCP is there but the cities need to re-evaluate their vision and recall what has gone right and wrong Need to trust municipalities and roped in emotionally to drive the mission and need to concentrate on a framework which has a SC plan for the entire city broken down into smart wards		
How Successful Is Modi Government's Smart Cities Mission? Urban Reality	"SC is not a destination but a journey" Positive conversation between cities, academia, industry professionals is something which SCM did Many professionals believe that unless physical infrastructure is in place, tech cannot be applied. Tech and infra are intertwined and cannot be seen as separate Tech will help in gathering data to plan cities and so cities can be planned in the traditional way through surveys but tech and data sources is making city planning alive: ICCC helps in planning where we need to Cities have seen improved traffic behavior, crime detection, better leakages, a general sense of safety and security have increased Now, physical infra cannot be treated independently and needs to use technology to plan them All the SPVs have appointed a chief data officer who manages data, having their own data strategy At the national level, data mining is being done and provide assistance to cities Data challenge is being planned to see what cities are doing with their data Water systems: having sensors and capture the data required to identify leakages, convergence between SCM and other missions -solar energy was brought in under SCM before that very few cities were working on solar energy -wastewater and storm management are big projects -Cities in Gujarat, Andhra, MP, and Maharashtra, Namchi is doing fantastic work -TN: 11 cities have come together to work on one cloud, cutting cost in implementing ICCC to reduce cost and leverage the strengths of each city -Northern cities are slowly picking up, Jammu and were late to start and Varanasi has done pretty well -Zero emissions in Ganga, doing well in waste management and water management -ICCC is up and running, -Kumbh in Allahabad was managed by ICCC (a big plus)	F, R&P	17-Feb-19

Report Name	Summary from report	Risk	Date
	-ABD: Cities now need to think about how they can scale the ABD projects, 20% of projects are financed by PPP -Bhopal is coming with a replicable framework for PPP -Value capture finance models are being implemented, there are fewer examples and cities need to pick up and need a lot of work -Municipal bonds are leveraged (35 and more cities are E- and above, this is the first time cities are going for credit rating) -TOD has picked up in all cities which are taking up metro and BRTS systems -Economic growth will come once the infrastructure is in place when people are healthy Retrofitting- land acquisition, it is a live city -In housing projects, waste management: repairing, identifying leakages has lowered the time -Keep engaging with your citizens, use tech to converge your sources to make plans, and building partnerships -MNCs need to keep engaging their citizens by making them aware of the new projects coming up, update on current projects -Indore and Mysore are so engaged and take pride in one of the cleanest cities, we need to create that sort of engagement to get results		
Progress report of the Smart Cities mission	As part of the Digitizing India series, CNBC TV18's Shereen Bhan is in conversation with the President, Cisco India & SAARC, Dinesh Malkani about the progress of the Smart Cities & Digital India missions, July 9, 2016 SCM focused on making cities to strategize city development by formulating Vision, Strategy, Investment, and Execution SPV connects the dots Competitive mission Learnings: Retrofitting projects: you know the biggest need of the city so you have the data to plan the city, You need to think of innovative ways around existing infrastructure, and monetize these projects in retrofitting development Direct involvement of CM and commissioner in some states pushes the cities to implement the projects There are two ways to develop city to incorporate the incoming population, add more infrastructure in a traditional way or smarten the existing infrastructure to efficiently accommodate incoming as well current population India has the most number of PPPs, SC are very data driven and the implementer can develop plans more objectively	S&E, F	July 9, 2016

Report Name	Summary from report	Risk	Date
	Strong leadership is very important for a successful project which means that a leader should see the value in a smart project and can measure the impact a project may have when implemented, Brownfield city- how tech will work in city environments, some trial errors is needed, scaling the project will lower the cost of these projects Direct impact-smart lighting, absolute reduction in energy efficiency, smart classrooms in government schools by including digital technology increase in attendance, number of challans cut in Lucknow, etc. Some infrastructure companies are also looking at technological solution, start-ups and incubation centers are coming up Safety and traffic management Skill development and employment in IoT and Digital literacy		
The Big Picture - Smart Cities project: How has it shaped up?	At the first ever conference of Smart City CEOs in #Bhopal, 77 CEOs share their experiences of turning Indian cities smart! On this special episode of Urban Reality we get you more details. Guests: M. Ramachandran, Former Union Secy., Urban Development and Advisor, UP Govt; Nitin Sethi, Associate Editor, Business Standard; Jamal H Ansari, Former Director, School of Planning & Architecture; Sudhir Krishna, Former Union Secy., Urban Development. Anchor: Girish Nikam		5-Feb-16
Venkaiah Naidu Speech At SMART & AMRUT Cities Mission Launch | NTV	Union Urban Minister Venkaiah Naidu delivered a speech at Smart & Amrut cities Launch and stated that the Government intends to spend Rs 48,000 crore on smart cities to be developed via PPP (Public & Private Partnership) model. Smart leadership and smart citizens, not only smart but more disciplined and welcoming citizens to adopt and move forward		24-Jun-15
The Big Picture - SMART CITY MISSION @ 100, Rajya Sabha TV	Anchor - Frank Pereira Prof. PK Sarkar, SPA Delhi 3 core areas: socio-economic aspects, physical components and institutional mechanism : if these 3 areas are focused then SCM can be put to maximum use Aim: better quality of life, people can move with better ease and safety Unsustainability issues have been witnessed in not only metropolitan cities but in smaller cities as well Acad: a very small fraction of projects have been implemented Surat, Pune, Vizag, Bhopal and Indore are leading Too much dependence on private partners, capacity building, Criticism Better areas taken for ABD development?		19-Jan-18

Report Name	Summary from report	Risk	Date
	Srikant Vishwanathan, CEO Janaagraha SCM is a mission with a bigger vision and should not be seen as 5 year period scheme An opportunity for the city and state government to be inspired by such missions and come up with their own similar missions Central govt can give a strong foundation, meta-framework for cities and the state but State gov are the ones which can empower the city It has raised energy levels of the young commissioners/ local govt which was much required in terms of policy focus and funding strategies SCM has moved the needle but not re-calibrated the urbanization process More funds to local commissioners Ecosystem of players to rally around municipalities Criticism Why ABD is focused than Pan? ABD: model to fix one city and how it can be replicated Impossible and irrelevant to do ABD in the whole city Too much dependence on central govt schemes Side stepping root cause challenges Policy framework , municipal staffing UDPFI: financially self-sufficient and accountable, political councils at the city level, city councils are so toothless SCM is more project focused The challenges which are brought up in SCM needs to be concurrently addressed not just through launching missions at national level but framing policy at national, state and local levels so that when later on some other schemes are launched, the activities should not be grappled with the same issues (and will again be hit but these challenges in 10-15 years) Lot more money and energy coming on the cities But building strong institution reform building and municipal building Some of the possible solutions Jaipur improved its scores on the back of passage of the Rajasthan Urban Land (Certification of Titles) Bill that enabled better urban land utilization," he said. Sameer Sharma, Director, SCM Urbanization happened in India by default 1979:Integration Megacities		

Report Name	Summary from report	Risk	Date
	JNNURM City is an ecosystem and thus needs an integration of different elements 3 layers: Basic: amrut, SBM, housing for all Technology: SCM Area based development: SCM LSE review of SCM: benefits of hard and soft infrastructure States like Maharashtra and MP are developing their own smart city policies India should come up with a National urbanization policy framework, under which state and cities will create their own policies 2 lac crores proposed 2500 Cr projects paid Slow implementation why? CCC: designing RFP related to this needs time, HP in MP, Honeywell in Bhubaneswar Roads: redesigning projects, more time in planning so that quality projects are delivered Innovative vigor is unleashed through SCM Central govt' role in the mission is to tell the cities about the various solutions, tools that can be used but it tis the city govt who needs to decide which solution they wish to adopt based on citizen consultations. 20 CCC are under implementation and 12 under tendering This is where local planning needs to be given more important		
Smart Cities Mission | 4 Years of Modi & the Progress Report | CNBC TV18,	Time takes to adjust with the political economy which is city oriented and to some extent Andhra, MP, Gujarat In UP: Varanasi is doing really good Worst performing: How board of SPV is more strategic and functional: will help in replicating the ABD area Technical capacity from government and Exec Engineers who are hand holding needs training-improvement in More often smart city sessions/workshops This lead to cities talking to each other which is making projects move more faster By June 108, 40,000 Cr will progress 40,000 Cr will be completed in Next June CCC is quick Road projects are going slow as compared to other projects	R&P	21-May-18
Smart Cities of India -	Omaxe CMD Rohtas Goel in an interview with CNBC Awaaz enumerates the strengths of	R&P	30-Oct-14

Report Name	Summary from report	Risk	Date
Lucknow; Omaxe Ltd. CMD Rohtas Geol with CBNC Awaaz	Lucknow as a potential Smart City, the different regions, booming service class and a superior connectivity What is Smart city? To use the available resources (even waste generation) to make cities sustainable, not alone a standalone process it needs job creation and not just physical infrastructure (as much as the people need a city, a city needs people) Where does LKo fit in? High Tech cities named projects are already conceived in various parts of the state. Land Acquisition is a difficult scene as the LA Act makes it difficult to acquire land. For developing ABD projects, 1500 sq feet of land is required but it was difficult to choose the area because of small pockets in the chosen land and hence implementation of projects could not start. Currently, implementation pace is not that slow: political will and bureaucracy is supportive of the schemes, land acquisition is a big challenge Rather looking outside India, look for consultancies and implementing agencies in the various parts of the country		

Annexure 4: Interview Review Board Approval

VIRGINIA TECH

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-3732 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE:	August 30, 2018
TO:	Ralph P Hall, Khushboo Gupta
FROM:	Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)
PROTOCOL TITLE:	To study the Smart City development in Developing Nations
IRB NUMBER:	18-459

Effective August 29, 2018, the Virginia Tech Institution Review Board (IRB) approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Expedited, under 45 CFR 46.110 category(ies) 5,7**
Protocol Approval Date:	**August 29, 2018**
Protocol Expiration Date:	**August 28, 2019**
Continuing Review Due Date*:	**August 14, 2019**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Once complete, upload this form as a Word document to the IRB Protocol Management System: https://secure.research.vt.edu/irb

Section 1: General Information

1.1 DO ANY OF THE INVESTIGATORS OF THIS PROJECT HAVE A REPORTABLE CONFLICT OF INTEREST? (http://www.irb.vt.edu/pages/researchers.htm#conflict)

☒ **No**
☐ **Yes,** explain:

1.2 IS THIS RESEARCH SPONSORED OR SEEKING SPONSORED FUNDS?

☒ **No,** go to question 2.1
☐ **Yes,** answer questions within table

IF YES
Provide the name of the sponsor [if NIH, specify department]:
Is this project receiving or seeking federal funds? ☐ No ☐ Yes **If yes,** **Does the grant application, OSP proposal, or "statement of work" related to this project include activities involving human subjects that are <u>not</u> covered within this IRB application?** ☐ No, all human subject activities are covered in this IRB application ☐ Yes, however these activities will be covered in future VT IRB applications, these activities include: ☐ Yes, however these activities have been covered in past VT IRB applications, the IRB number(s) are as follows: ☐ Yes, however these activities have been or will be reviewed by another institution's IRB, the

name of this institution is as follows:

☐ Other, explain:

Is Virginia Tech the primary awardee or the coordinating center of this grant?

☐ No, provide the name of the primary institution:

☐ Yes

Section 2: Justification

2.1 DESCRIBE THE BACKGROUND, PURPOSE, AND ANTICIPATED FINDINGS OF THIS STUDY:

In early 2000s, the smart city development was all about reforms based on technological advancement through data, monitoring, interconnectedness and automatic steering mechanisms leading to profit making mechanism for the tech companies. However, in the present scenario technological advancement is seen as a means to focus on the immediate tasks such as reducing traffic congestion, providing affordable housing and efficient utility services, and healthcare. These issues further aggravate in a developing country context with existing poverty level, increasing migration rates from rural to urban areas, growing slums, and lack of backbone infrastructure including water and waste water services, power supply, lack of sanitation, etc. The smart city development in the cities in developing countries, therefore, not only need projects which include Information and Communication Technology (ICT) but those which focus on providing the basic infrastructure to citizens to ensure a decent quality of life in addition to multi-modal transport options, clean environment and safe communities. Further, Smart Cities (SC) are seen an avenue to advance the ongoing and the planned activities using ICT to obtain efficient project delivery. With growing population in each of cities, the city government needs to take 'smart' actions in order to accommodate them and provide citizens an improved quality of life. But this alone cannot be achieved by employing ICT, instead investment in human and physical infrastructure is needed as well.

Post 2010 period witnessed several SC initiatives being undertaken in developing nations in addition to developed nations. The aim of these smart city initiatives is to improve the quality of life of their citizens and included initiatives such as National Smart City Programme, China (2012), Smart Dubai (2013), Smart City Cairo, Egypt (2015), Smart Cities Mission, India (2015), Nigeria Smart City Initiative (2017), etc. These initiatives in the emerging economies provide a unique opportunity to examine them in the backdrop of smart cities which exist in the developed nations and in the Smart City literature. This research will focus on one of the above mentioned initiatives, namely, Indian Smart Cities Mission which is in the implementation period.

A preliminary analysis indicated that there are similarities and differences between Indian cities' vision statements and existing smart city definitions. In addition, the qualitative analysis of 'Smart Urban form' described in the Smart City Proposals for six cities indicated that more than half of the characteristics do not employ ICT, still are kept under 'Smart Urban' form which may result in safer and environment friendly neighborhood, in addition to providing a decent standard of living to the citizens. These findings again reinforce the need to examine the objective of smart city development in developing countries such as India than focusing on just ICT applications through various smart city initiatives.

The study seeks to investigate: How does an emerging economy like India conceptualize the notion of a smart city? How is it similar to or different from existing conceptualizations? What are the barriers in the smart city project implementation?

It is anticipated that this research will provide an opportunity to gain a clear understanding of smart city development in reference to a developing nation such as India.

I have reviewed the International Regulations for human subject research for India and there are no regulations that apply to this study.

2.2 EXPLAIN WHAT THE RESEARCH TEAM PLANS TO DO WITH THE STUDY RESULTS:

For example - publish or use for dissertation

The results of this study will be used for my PhD dissertation which focuses on defining smart cities in the context of developing countries. I will also be using these interviews and survey responses for publishing my findings for academic purposes so other interested people may learn from this research.

Section 3: Recruitment

3.1 DESCRIBE THE SUBJECT POOL, INCLUDING INCLUSION AND EXCLUSION CRITERIA AND NUMBER OF SUBJECTS:

Examples of inclusion/exclusion criteria - gender, age, health status, ethnicity

Key Informant Interviews will be the primary data collection tool to be used in this study for obtaining an in-depth understanding of smart city development in the Indian context. Open ended questions will be asked to three target groups which include Government Officials, Academic professionals, and Industry professionals who closely work in planning and implementing smart city projects in India.

The government officials will include members from Special Purpose Vehicles (SPV) and local municipalities at the city level who are responsible for implementing projects under Smart Cities Mission. From 100 proposed smart cities, government officials associated with Special purpose Vehicle and Municipalities in Kanpur and Kakinada will be contacted. The contact information for the government officials will be obtained from the city municipality's website. Familiar background of these cities and better access to interviewees is the main reason to conduct interviews in these two cities. The interviews may extend to government officials in some other cities such as Kota, Jaipur, Aligarh and New Delhi.

People in Academia and Industry will be identified through the platform of ResearchGate (https://www.researchgate.net/), which is a public forum where researchers can showcase their research working on any scientific domain. Researchers working on smart city and related aspects in India will be identified by the publications showcased by them on 'ResearchGate' and contacted via sending them email on their public email address available on ResearchGate.

3.2 WILL EXISTING RECORDS BE USED TO IDENTIFY AND CONTACT / RECRUIT SUBJECTS?

Examples of existing records - directories, class roster, university records, educational records

☐ **No,** go to question 3.3

☒ **Yes,** answer questions within table

IF YES
Are these records private or public? ☒ Public ☐ Private, describe the researcher's privilege to the records:
Will student, faculty, and/or staff records or contact information be requested from the University? ☒ No ☐ Yes, provide a description under Section 14 (Research Involving Existing Data) below.

3.3 DESCRIBE RECRUITMENT METHODS, INCLUDING HOW THE STUDY WILL BE ADVERTISED OR INTRODUCED TO SUBJECTS:

1. The researcher will contact the potential interview subjects via email, asking them to participate in the study (see email template).
2. If the participant responds, the researcher will send a second email to schedule the interview with the consent script (in english) attached.

3. The in person or skype/phone interviews will be scheduled at the convenience of the interviewee.

3.4 PROVIDE AN EXPLANATION FOR CHOOSING THIS POPULATION:

Note: the IRB must ensure that the risks and benefits of participating in a study are distributed equitably among the general population and that a specific population is not targeted because of ease of recruitment.

Since the research focuses on smart city development, interviews will be conducted only in the proposed smart cities to explore the understanding of smart cities in India. People who are closely associated with smart city development, for instance doing research on related area, implementing projects under Smart Cities Mission and/or are industry partners in the mission activities will only be included in the study population. Thus, this study targets essentially local government bodies, industry partners and academicians for example, planners and engineers working in the area of smart city development.

Section 4: Consent Process

For more information about consent process and consent forms visit the following link:
http://www.irb.vt.edu/pages/consent.htm

If feasible, researchers are advised and may be required to obtain signed consent from each participant unless obtaining signatures leads to an increase of risk (e.g., the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting in a breach of confidentiality). Signed consent is typically not required for low risk questionnaires (consent is implied) unless audio/video recording or an in-person interview is involved. If researchers will not be obtaining signed consent, participants must, in most cases, be supplied with consent information in a different format (e.g., in recruitment document, at the beginning of survey instrument, read to participant over the phone, information sheet physically or verbally provided to participant).

4.1 CHECK ALL OF THE FOLLOWING THAT APPLY TO THIS STUDY'S CONSENT PROCESS:

☒ Verbal consent will be obtained from participants
☐ Signed consent will be obtained from participants
☐ Consent will be implied from the return of completed questionnaire. Note: The IRB recommends providing consent information in a recruitment document or at the beginning of the questionnaire (if the study only involves implied consent, skip to Section 5 below)
☐ Other, describe:

4.2 PROVIDE A GENERAL DESCRIPTION OF THE PROCESS THE RESEARCH TEAM WILL USE TO OBTAIN AND MAINTAIN INFORMED CONSENT:

During the recruitment process, the study will be introduced to the participants via email. The informed consent form will be attached to the recruitment email. Thus, potential participants will have time to read over the consent form and ask any questions they might have via email. If they agree to participate in the study, an interview time (in December, 2018) and place will be set-up. The interviews may take place in person or via phone/skype. Prior to starting the interview, the consent form will be reviewed with the participant, who will be asked for a verbal consent, understanding that they may withdraw consent at any time. The consent form (in English) will clearly state that the participant may decline to answer any questions they wish.

Signed consent for the interviews is not requested because a written consent will increase the risk for the participant as he/she could be identified.

4.3 WHO, FROM THE RESEARCH TEAM, WILL BE OVERSEEING THE PROCESS AND OBTAINING CONSENT FROM SUBJECTS?

The researcher (Khushboo Gupta) will be obtaining the consent from the interviewees.

4.4 WHERE WILL THE CONSENT PROCESS TAKE PLACE?

A verbal consent will be obtained from the participant before the interview starts.

For In-person interview, the consent will take place in the interviewee's office.

For Phone/skype interview, the consent will be obtained on call (skype/phone) before the interview starts.

4.5 DURING WHAT POINT IN THE STUDY PROCESS WILL CONSENTING OCCUR?

Note: unless waived by the IRB, participants must be consented before completing any study procedure, including screening questionnaires.

Verbal consent will occur before each interview. Interviewees will be free to stop the interview at any point with no penalty.

4.6 IF APPLICABLE, DESCRIBE HOW THE RESEARCHERS WILL GIVE SUBJECTS AMPLE TIME TO REVIEW THE CONSENT DOCUMENT BEFORE SIGNING:

Note: typically applicable for complex studies, studies involving more than one session, or studies involving more of a risk to subjects.

☒ Not applicable

Section 5: Procedures

5.1 PROVIDE A STEP-BY-STEP THOROUGH EXPLANATION OF ALL STUDY PROCEDURES EXPECTED FROM STUDY PARTICIPANTS, INCLUDING TIME COMMITMENT & LOCATION:

After receiving the recruitment email and consent form, the participant will email or call the researcher to agree to participate in an interview. If a participant expresses an interest in the study, the following steps will be take:

1. The researcher and participants will arrange for a 45-60 minutes interview (in December, 2018) that may take place in person or via phone/skype, whichever is the most convenient for the participant.

2. On the day of the interview, participants will be able to ask any questions about the study before being asked for a verbal consent, with the understanding that they may choose not to answer a question or withdraw consent at any time.

3. The interview will begin with the researcher asking questions of the participant according to the interview script. Probing/follow-up questions may be used to obtain further detail.

4. The researcher may ask the participants if they can be contacted again with follow-up questions after each interview. If the participant consents, the researcher may ask additional questions at a later date.

Open ended questions will be asked to participants, which include government officials, people in academia, and industry professionals. The questions will explore what the participant understand by the term 'smart' and how is it been applied in the Indian context through the Smart Cities Mission. Around 50 interviews are planned, 15 from each city and 20 interviewees will be from Industry and Academia.

5.2 DESCRIBE HOW DATA WILL BE COLLECTED AND RECORDED:

Open ended interviews will be conducted via skype/video/phone call or will be conducted in-person in the interviewee's office and detailed notes will be taken. Researcher will take very detailed notes by hand (or typed) during the interview. Within 48 hours they will write an

electronic summary of all notes. The notes and summaries will be collected and stored in one electronic folder for coding and analysis.

5.3 DOES THE PROJECT INVOLVE ONLINE RESEARCH ACTIVITES (INCLUDES ENROLLMENT, RECRUITMENT, SURVEYS)?

View the "Policy for Online Research Data Collection Activities Involving Human Subjects" at http://www.irb.vt.edu/documents/onlinepolicy.pdf

☒ **No,** go to question 6.1

☐ **Yes,** answer questions within table

IF YES
Identify the service / program that will be used: ☐ www.survey.vt.edu, go to question 6.1 ☐ SONA, go to question 6.1 ☐ Qualtrics, go to question 6.1 ☐ Center for Survey Research, go to question 6.1 ☐ Other **IF OTHER:** Name of service / program: URL: This service is… ☐ Included on the list found at: http://www.irb.vt.edu/pages/validated.htm ☐ Approved by VT IT Security ☐ An external service with proper SSL or similar encryption (https://) on the login (if applicable) and all other data collection pages. ☐ None of the above (note: only permissible if this is a collaborative project in which VT individuals are only responsible for data analysis, consulting, or recruitment)

Section 6: Risks and Benefits

6.1 WHAT ARE THE POTENTIAL RISKS (E.G., EMOTIONAL, PHYSICAL, SOCIAL, LEGAL, ECONOMIC, OR DIGNITY) TO STUDY PARTICIPANTS?

Potential risks to study participants are minimal. Through the consent process researchers will

make it clear that the participants may refrain from answering any questions they feel are threatening.

6.2 EXPLAIN THE STUDY'S EFFORTS TO REDUCE POTENTIAL RISKS TO SUBJECTS:

To maintain participant confidentiality, the information gathered in these interviews will be presented in aggregate for publication or presentation in academic conferences. Researchers will use pseudonyms if referring to or quoting individual interview participants, avoiding descriptive characteristics that may identify the participant. During each interview, participants can request that any comment they make should remain off the record. For instance, if they are uncomfortable openly critiquing the central or state government, researchers will mark those comments and not use them.

6.3 WHAT ARE THE DIRECT OR INDIRECT ANTICIPATED BENEFITS TO STUDY PARTICIPANTS AND/OR SOCIETY?

The research findings will help the people in academia in conceptualizing how smart cities are understood in the context of Indian Smart Cities Mission. Additionally, how different it is (or not) from the smart cities described in the literature. Further, the framework obtained as an outcome of the research work can be used by several communities planning to transition into a smart community for proposing a smart project as well as identifying mitigation measures in response to the challenges city officials face in implementing these projects. The research findings will also be available to the interviewees to provide them a comparison of the activities done in their city with respect to other competing cities in India.

Section 7: Full Board Assessment

7.1 DOES THE RESEARCH INVOLVE MICROWAVES/X-RAYS, OR GENERAL ANESTHESIA OR SEDATION?

☒ **No**
☐ **Yes**

7.2 DO RESEARCH ACTIVITIES INVOLVE PRISONERS, PREGNANT WOMEN, FETUSES, HUMAN IN VITRO FERTILIZATION, OR INDIVIDUALS WITH MENTAL DISORDERS?

☒ **No,** go to question 7.3
☐ **Yes,** answer questions within table

IF YES
This research involves: ☐ Prisoners ☐ Pregnant women ☐ Fetuses ☐ Human in vitro fertilization ☐ Individuals with a mental disorder

7.3 DOES THIS STUDY INVOLVE MORE THAN MINIMAL RISK TO STUDY PARTICIPANTS?

Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily activities or during the performance of routine physical or psychological examinations or tests. Examples of research involving greater than minimal risk include collecting data about abuse or illegal activities. Note: if the project qualifies for Exempt review (http://www.irb.vt.edu/pages/categories.htm), it will not need to go to the Full Board.

☒ **No**
☐ **Yes**

IF YOU ANSWERED "YES" TO ***ANY ONE*** OF THE ABOVE QUESTIONS, 7.1, 7.2, OR 7.3, THE BOARD MAY REVIEW THE PROJECT'S APPLICATION MATERIALS AT ITS MONTHLY MEETING. VIEW THE FOLLOWING LINK FOR DEADLINES AND ADDITIONAL INFORMATION:
http://www.irb.vt.edu/pages/deadlines.htm

Section 8: Confidentiality / Anonymity

For more information about confidentiality and anonymity visit the following link:
http://www.irb.vt.edu/pages/confidentiality.htm

8.1 WILL PERSONALLY IDENTIFYING STUDY RESULTS OR DATA BE RELEASED TO ANYONE OUTSIDE OF THE RESEARCH TEAM?

For example – to the funding agency or outside data analyst, or participants identified in publications with individual consent

☒ **No**

☐ **Yes,** to whom will identifying data be released?

8.2 WILL THE RESEARCH TEAM COLLECT AND/OR RECORD PARTICIPANT IDENTIFYING INFORMATION (E.G., NAME, CONTACT INFORMATION, VIDEO/AUDIO RECORDINGS)?

Note: if collecting signatures on a consent form, select "Yes."

☐ **No,** go to question 8.3

☒ **Yes,** answer questions within table

IF YES
Describe if/how the study will utilize study codes: **It is not anticipated that there will be a need to utilize identifying information of interviewees as part of the data analysis or dissertation narrative. The only information which may be used is the place and their profession/industry.** **Regardless, each interview memo will include a code for city and profession. A Separate sheet will include code related to position of the interviewee and their organization. Each of these attributes will receive a unique numerical identifier.**
If applicable, where will the key [i.e., linked code and identifying information document (for instance, John Doe = study ID 001)] **be stored and who will have access?** **The key will be included in the code sheet which will be stored on the researcher's laptop which is password protected and can be accessed by the researcher and will only be shared with the P.I. of the project.** *Note: the key should be stored separately from subjects' completed data documents and accessibility should be limited.*
The IRB strongly suggests and may require that all data documents (e.g., questionnaire responses, interview responses, etc.) do not include or request identifying information (e.g., name, contact information, etc.) from participants. If you need to link subjects' identifying information to subjects' data documents, use a study ID/code on all data documents.

8.3 HOW WILL DATA BE STORED TO ENSURE SECURITY (E.G., PASSWORD PROTECTED COMPUTERS, ENCRYPTION) AND LIMITED ACCESS?

Examples of data - questionnaire, interview responses, downloaded online survey data, observation recordings, biological samples

All data collected will be stored on password-protected computers used by the researcher (Khushboo Gupta).

8.4 WHO WILL HAVE ACCESS TO STUDY DATA?

Researcher (Khushboo Gupta) and PI

8.5 DESCRIBE THE PLANS FOR RETAINING OR DESTROYING STUDY DATA:

Upon publishing the results from the research, all paper notes as well as related folders on computer will be deleted.

8.6 DOES THIS STUDY REQUEST INFORMATION FROM PARTICIPANTS REGARDING ILLEGAL BEHAVIOR?

☒ **No,** go to question 9.1

☐ **Yes,** answer questions within table

IF YES
Does the study plan to obtain a Certificate of Confidentiality? ☐ No ☐ Yes (Note: participants must be fully informed of the conditions of the Certificate of Confidentiality within the consent process and form) *For more information about Certificates of Confidentiality, visit the following link:* *http://www.irb.vt.edu/pages/coc.htm*

Section 9: Compensation

For more information about compensating subjects, visit the following link:
http://www.irb.vt.edu/pages/compensation.htm

9.1 WILL SUBJECTS BE COMPENSATED FOR THEIR PARTICIPATION?

☒ **No,** go to question 10.1

☐ **Yes,** answer questions within table

IF YES
What is the amount of compensation?
Will compensation be prorated? ☐ Yes, please describe: ☐ No, explain why and clarify whether subjects will receive full compensation if they withdraw from the study? *Unless justified by the researcher, compensation should be prorated based on duration of study participation. Payment must <u>not</u> be contingent upon completion of study procedures. In other words, even if the subject decides to withdraw from the study, he/she should be compensated, at least partially, based on what study procedures he/she has completed.*

Section 10: Audio / Video Recording

For more information about audio/video recording participants, visit the following link:
http://www.irb.vt.edu/pages/recordings.htm

10.1 WILL YOUR STUDY INVOLVE VIDEO AND/OR AUDIO RECORDING?

☒ **No,** go to question 11.1

☐ **Yes,** answer questions within table

IF YES
This project involves: ☐ Audio recordings only ☐ Video recordings only ☐ Both video and audio recordings
Provide compelling justification for the use of audio/video recording:

How will data within the recordings be retrieved / transcribed?
How and where will recordings (e.g., tapes, digital data, data backups) be stored to ensure security? r
Who will have access to the recordings?
Who will transcribe the recordings?
When will the recordings be erased / destroyed?

Section 11: Research Involving Students

11.1 DOES THIS PROJECT INCLUDE STUDENTS AS PARTICIPANTS?

☒ **No,** go to question 12.1

☐ **Yes,** answer questions within table

IF YES
Does this study involve conducting research with students of the researcher? ☐ No ☐ Yes, describe safeguards the study will implement to protect against coercion or undue influence for participation: *Note: if it is feasible to use students from a class of students not under the instruction of the researcher, the IRB recommends and may require doing so.*
Will the study need to access student records (e.g., SAT, GPA, or GRE scores)? ☐ No ☐ Yes

11.2 DOES THIS PROJECT INCLUDE ELEMENTARY, JUNIOR, OR HIGH SCHOOL STUDENTS?

☒ **No,** go to question 11.3

☐ **Yes,** answer questions within table

IF YES
Will study procedures be completed during school hours? ☐ No ☐ Yes **If yes,** **Students not included in the study may view other students' involvement with the research during school time as unfair. Address this issue and how the study will reduce this outcome:** **Missing out on regular class time or seeing other students participate may influence a student's decision to participate. Address how the study will reduce this outcome:**
Is the school's approval letter(s) attached to this submission? ☐ Yes ☐ No, project involves Montgomery County Public Schools (MCPS) ☐ No, explain why: *You will need to obtain school approval (if involving MCPS, click here: http://www.irb.vt.edu/pages/mcps.htm). Approval is typically granted by the superintendent, principal, and classroom teacher (in that order). Approval by an individual teacher is insufficient. School approval, in the form of a letter or a memorandum should accompany the approval request to the IRB.*

11.3 DOES THIS PROJECT INCLUDE COLLEGE STUDENTS?

☒ **No,** go to question 12.1

☐ **Yes,** answer questions within table

IF YES
Some college students might be minors. Indicate whether these minors will be included in the research or actively excluded: ☐ Included

☐ Actively excluded, describe how the study will ensure that minors will not be included:

Will extra credit be offered to subjects?

☐ No

☐ Yes

If yes,

What will be offered to subjects as an equal alternative to receiving extra credit without participating in this study?

Include a description of the extra credit (e.g., amount) to be provided within question 9.1 ("IF YES" table)

Section 12: Research Involving Minors

12.1 DOES THIS PROJECT INVOLVE MINORS (UNDER THE AGE OF 18 IN VIRGINIA)?

Note: age constituting a minor may differ in other States.

☒ **No,** go to question 13.1

☐ **Yes,** answer questions within table

IF YES
Does the project reasonably pose a risk of reports of current threats of abuse and/or suicide? ☐ No ☐ Yes, thoroughly explain how the study will react to such reports: *Note: subjects and parents must be fully informed of the fact that researchers must report threats of suicide or suspected/reported abuse to the appropriate authorities within the Confidentiality section of the Consent, Assent, and/or Permission documents.*
Are you requesting a waiver of parental permission (i.e., parent uninformed of child's involvement)? ☐ No, **both** parents/guardians will provide their permission, if possible.

☐ No, **only one** parent/guardian will provide permission.

☐ Yes, describe below how your research meets **all** of the following criteria (A-D):

Criteria A - The research involves no more than minimal risk to the subjects:

Criteria B - The waiver will not adversely affect the rights and welfare of the subjects:

Criteria C - The research could not practicably be carried out without the waiver:

Criteria D - (Optional) Parents will be provided with additional pertinent information after participation:

Is it possible that minor research participants will reach the legal age of consent (18 in Virginia) while enrolled in this study?

☐ No

☐ Yes, will the investigators seek and obtain the legally effective informed consent (in place of the minors' previously provided assent and parents' permission) for the now-adult subjects for any ongoing interactions with the subjects, or analysis of subjects' data? If yes, explain how:

For more information about minors reaching legal age during enrollment, visit the following link: http://www.irb.vt.edu/pages/assent.htm

*The procedure for obtaining assent from minors and permission from the minor's guardian(s) must be described in **Section 4** (Consent Process) of this form.*

Section 13: Research Involving Deception

For more information about involving deception in research and for assistance with developing your debriefing form, visit our website at http://www.irb.vt.edu/pages/deception.htm

13.1 DOES THIS PROJECT INVOLVE DECEPTION?

☒ **No,** go to question 14.1

☐ **Yes,** answer questions within table

IF YES
Describe the deception:
Why is the use of deception necessary for this project?
Describe the debriefing process:

Provide an explanation of how the study meets <u>all</u> the following criteria (A-D) for an alteration of consent:

Criteria A - The research involves no more than minimal risk to the subjects:

Criteria B - The alteration will not adversely affect the rights and welfare of the subjects:

Criteria C - The research could not practicably be carried out without the alteration:

Criteria D - (Optional) Subjects will be provided with additional pertinent information after participation (i.e., debriefing for studies involving deception):

By nature, studies involving deception cannot provide subjects with a complete description of the study during the consent process; therefore, the IRB must allow (by granting an alteration of consent) a consent process which does not include, or which alters, some or all of the elements of informed consent.

The IRB requests that the researcher use the title "Information Sheet" instead of "Consent Form" on the document used to obtain subjects' signatures to participate in the research. This will adequately reflect the fact that the subject cannot fully consent to the research without the researcher fully disclosing the true intent of the research.

Section 14: Research Involving Existing Data

14.1 WILL THIS PROJECT INVOLVE THE COLLECTION OR STUDY/ANALYSIS OF EXISTING DATA DOCUMENTS, RECORDS, PATHOLOGICAL SPECIMENS, OR DIAGNOSTIC SPECIMENS?

Please note: it is not considered existing data if a researcher transfers to Virginia Tech from another institution and will be conducting data analysis of an on-going study.

☐ **No,** you are finished with the application

☒ **Yes,** answer questions within table

IF YES
From where does the existing data originate? **The existing data will include proposals, associated annexures, office memorandums and reports, which are publically available and can be obtained from the website of Smart Cities Mission's website (http://smartcities.gov.in/content/).**
Provide a detailed description of the existing data that will be collected or studied/analyzed: **The proposals are documents prepared by the city officials in collaboration with private consultancies from the proposed smart cities in India, which include envisioning their smart**

city, describing the smart urban form, including the strategic plan to implement these projects, etc. Further these proposals have annexures to support their proposed strategies in detail such as cost break-up, organizations involved in implementing these projects.

The other reports include defining various terms used in the mission, objective and timeline of the mission, people involved in framing and implementing mission at the national level and evaluating mechanism used by them.
Office memorandums include the orders released by the government in relation with the mission activities which describes how many activities have been carried out according to the proposed plan and what all changes are made by the mission council, since this mission was launched.

Is the source of the data public?

☐ No, continue with the next question

☒ Yes, you are finished with this application

Will any individual associated with this project (internal or external) have access to or be provided with existing data containing information which would enable the identification of subjects:

- **Directly** (e.g., by name, phone number, address, email address, social security number, student ID number), or
- **Indirectly through study codes** even if the researcher or research team does not have access to the master list linking study codes to identifiable information such as name, student ID number, etc
  or
- **Indirectly through the use of information that could reasonably be used in combination to identify an individual** (e.g., demographics)

☐ No, collected/analyzed data will be completely de-identified

☐ Yes,

If yes,

Research will not qualify for exempt review; therefore, if feasible, written consent must be obtained from individuals whose data will be collected / analyzed, unless this requirement is waived by the IRB.

Will written/signed or verbal consent be obtained from participants prior to the analysis of collected data?

This research protocol represents a contract between all research personnel associated with the project, the University, and federal government; therefore, must be followed accordingly and kept current.

Proposed modifications must be approved by the IRB prior to implementation except where necessary to eliminate apparent immediate hazards to the human subjects.

Do not begin human subjects activities until you receive an IRB approval letter via email.

It is the Principal Investigator's responsibility to ensure all members of the research team who interact with research subjects, or collect or handle human subjects data have completed human subjects protection training prior to interacting with subjects, or handling or collecting the data.

----------END----------

Sample Questions

1. What do you think when you hear the term "smart city"? (Defining Smartness)
   [PROBE] E.g., How are smart cities different from the cities existing in India now?
2. Does becoming smart important for cities in India?
   [Follow-up Q]: Why do you think so? (Goals)
3. How do you think the current cities in India can be transformed into the type of smart city you just described? (Discussing Enablers)
4. What are some of the critical urban challenges in India which need attention? (Type of projects and their need)
5. According to your observation, are the projects being implemented under the Smart Cities Mission responding to the urban challenges you just mentioned? If yes, how? (Type of projects and their need)
6. In your view, are these projects adding value to the city (in the short or long term)? Why or Why not? (Goals)
7. What are the challenges/risks municipalities are facing (or may face) in implementing smart city projects? (Risks)
   [Follow-up Q] According to your close association with SC project implementation, what is the source of these challenges? (Risks)
8. How do you think these challenges can be mitigated? (Enablers Related)
   [Follow-up Q] Does Smart Cities Mission provide some mechanism to handle these challenges? (Enablers Related)
9. Is there something ‘smart’ about the Smart Cities Mission? If yes, what is it? (Defining Smartness)
10. Is this mission different from the previous missions such as Jawaharlal Nehru Urban Renewal Scheme? If yes, how? (Reflection on SCM)

Annexure 5: Structure of Special Purpose Vehicle

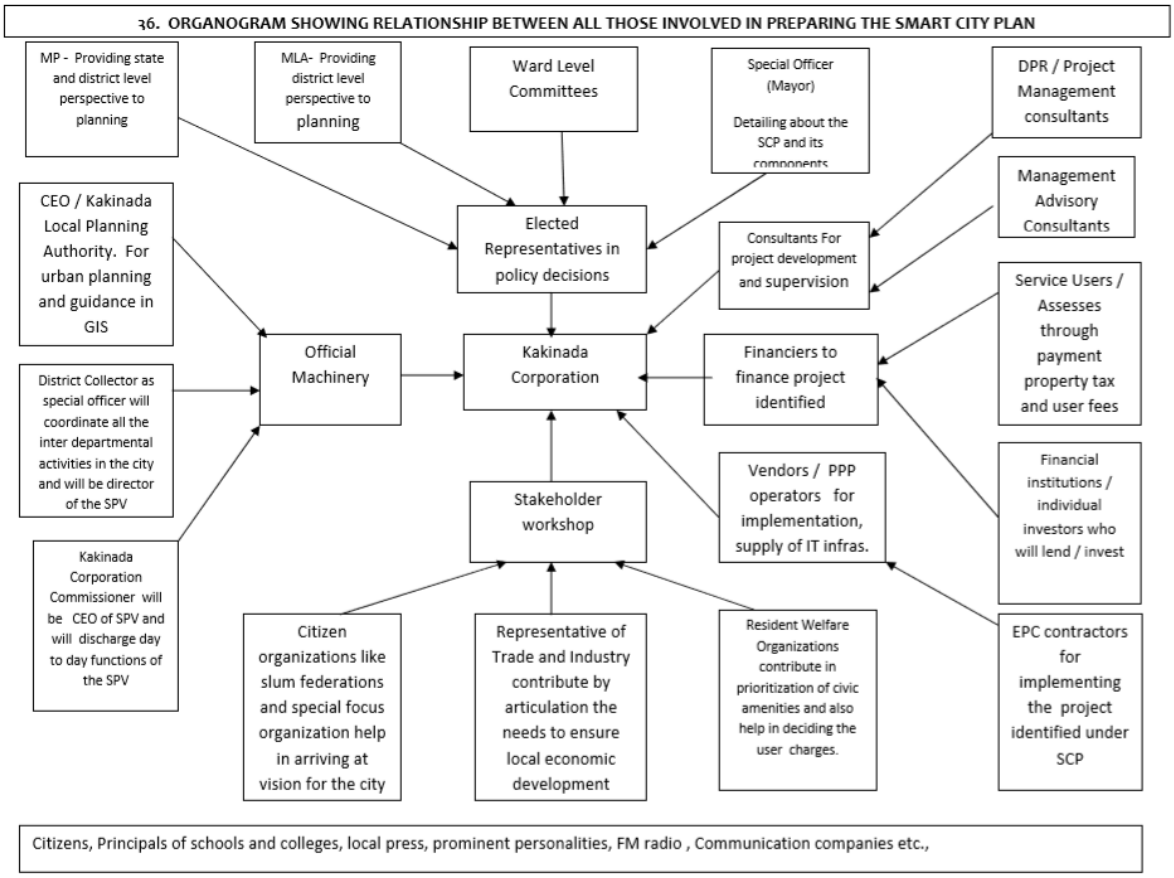


Figure 18: Organogram of Kakinada SPV (From Smart City Annexures of Kakinada)

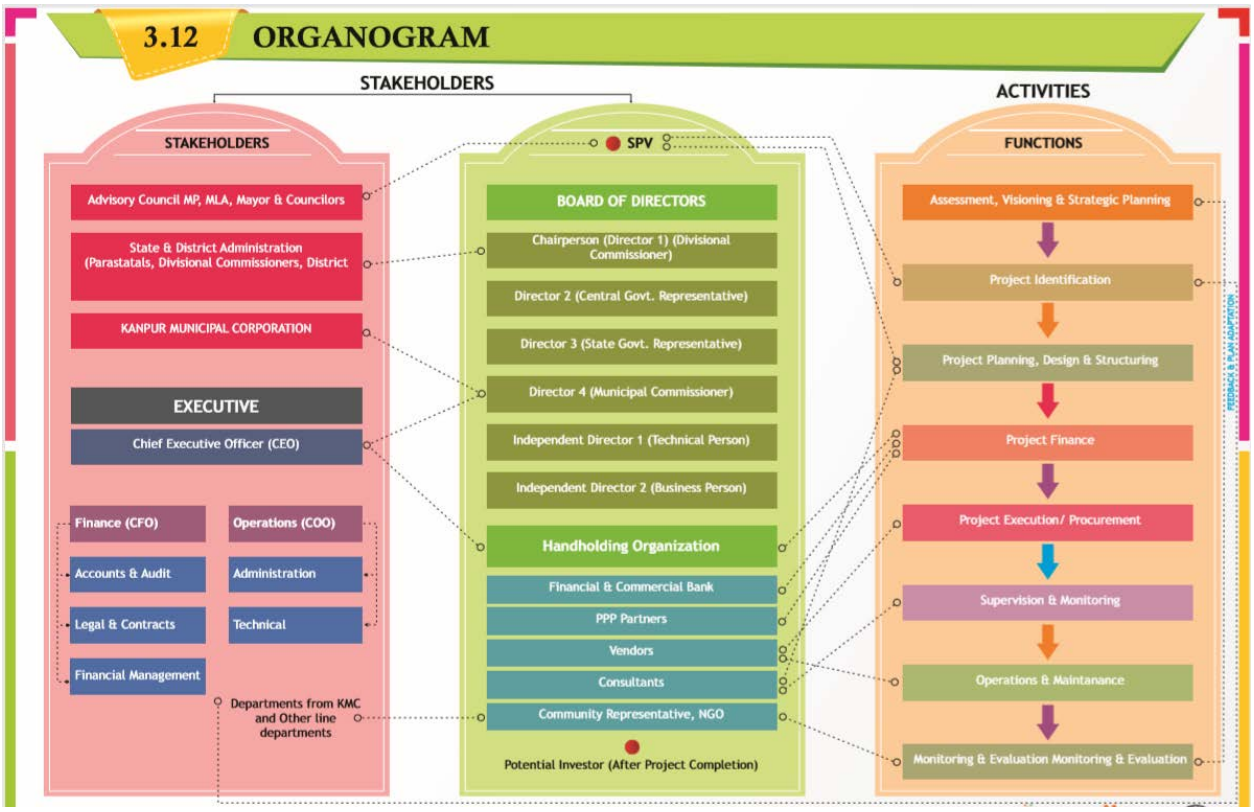


Figure 19: Organogram of Kanpur SPV (From Smart City Annexures of Kanpur)