

DIGITAL TRANSFORMATIONS IN INDIAN CITIES:
BETWEEN PAPER LIST AND GIS MAP

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ITC dissertation number 246
ITC, P.O. Box 217, 7500 AA Enschede, The Netherlands

ISBN 978-90-365-3654-7
DOI 10.3990/1.9789036536547
Cover designed by Job Duim
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UNIVERSITY OF TWENTE.

ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

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DISSERTATION

to obtain
the degree of doctor at the University of Twente,
on the authority of the rector magnificus,
prof.dr. H. Brinksma,
on account of the decision of the graduation committee,
to be publicly defended
on Wednesday 30 April 2014 at 14.45 hrs

by

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Acknowledgements

First of all, I need to acknowledge, and thankfully so, that the number of people, who have contributed to this research is too long to be captured in one list. The following list has to remain in a stage of incompleteness; and there are overlaps in categories.

My gratitude belongs to my promoter, Prof. Yola Georgiadou, who gave me the opportunity to embark on this research, supported me to see it through down to the very last words of the bibliography, encouraged me to look beyond one section of the library and guided me through the pages read and written. Whenever I had a concern or question, she offered a chair to discuss (during travels: digitally). Thank you!

I am very grateful to my supervisors, Dr. Karin Pfeffer and Dr. Gianluca Miscione, for their theoretical and practical advice, especially on the how-tos of ethnographic methodology, their feedback on many versions of texts, and their never-ceasing support and encouragement inside and outside of academic headquarters.

I very much thank Prof. I.S.A.Baud, Prof. Rahul De', Prof. Sridharan, and Dr. Javier Martinez for helping me keep the facts straight as much as for allowing me to question the facts, and for drawing a line of hospitality on the map to travel between Indian and Dutch cities.

Many, many thank-you-s also go to Dr. Neeraj Misra, Tara van Dijk, and Prasanna Kolte for literature suggestions, hints and hands-on lessons on how get around Indian cities, and especially the many thoughtful and comforting conversations over good food with a healthy pinch of humor.

I am very thankful to the many people I have met in India, who allowed and invited me to spend hours in their homes and offices, for sharing their tea, time and knowledge with me, and for the lessons I have learned that I could not have learned from text books. My greatest debt accumulated during this research goes to people in Indian administration, whom I cannot name here. Special thanks go to Gururaja Budhya, Prof. Krishne Gowda and family, Prof. Harish Ramaswamy, Manoshi Lahiri, Shibani and Denny Tait, the Kolte family, Dr. Geetanjoy and Kalpana Sahu, Elsa Mathews, Riju, Shashi, and Rukmini. I thank Prof. Carol Upadhya for her invitations to several inspiring seminars and lunch discussions at the National Institute of Advanced Studies in Bangalore, and Prof. Jan Brouwer and family, as well as Prof. Ramarao Indira for the wonderful music evenings at home and in town.

This research would not have been possible without the funding provided by the Netherlands Organization for Scientific Research – Science for Global Development (NWO-Wotro) and the information infrastructure provided by the Faculty of Geo-Information Science and Earth Observation (ITC) at the University of Twente. I greatly appreciate having had the opportunity at ITC to learn among and from scholars and practitioners with such diverse biographies and understandings. ITC also hosts my favourite library; and I very much thank Carla Gerritsen, Desiree Snoek, and Marga Koelen for locating knowledge from many corners of the Netherlands and beyond. Loes Colenbrander not only formatted this text into a legible shape, but also calmed down a nervous student in the process. Job Duim and Cecille Plomp visualized our research program’s story on many occasions, and Petra Weber always kept me informed and involved even when I was not physically present. Sukhad Keshkamat found me a place to live in Mumbai and in Amsterdam, as well as a translator for the Dutch summary, and allowed me to bring up and reflect on several more experimental interpretive ideas about field notes. Priyasmita Roy helped with several Hindi to English translations. Many, many thanks!

The last one and a half years have now put me into the fortunate situation of getting to add another acknowledgement paragraph in order to thank the faculty, staff, and students at the Department of Human Geography, Planning, and International Development at the University of Amsterdam for welcoming me with new and inspiring challenges, and for their optimistic support that lined both my trails into unknown territories as well as the final laps on my PhD track.

I thankfully acknowledge the examining committee for reviewing this thesis, as well as the anonymous reviewers’ comments on the published sections of the book, but also comments on those passages that did not go public, but nevertheless became valuable steps the research.

As always, my heartfelt gratitude goes to my family and friends for their love and helping hands, and especially in the last months for the many text messages that asked, if I was still alive or simply said: “Schreib!”

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PART I: Research Perspective & Methodology

PREAMBLE: a brief axiological note

A faint memory suddenly, somehow, crossed my mind while working on the thesis manuscript during the last months – one that seems to address one of science's "-ologies," namely axiology. I called my father and asked him to go search on the book shelves for a little yellow Reclam book with the title "*Ich und Du*" by *Martin Buber* ("I and You" in Kaufmann's translation). A few days later it arrived by post. I skimmed through the pages, found a passage, which I had underlined around 15 years ago and thought, "*Could this text passage - as I had understood it in the past and since then submerged in the abyss of my memory - have been the philosophical and ethical engine driving my moves during the PhD research?*" I cannot be sure, but it may ring a bell also with the reader later on in the thesis:

Humans become I through the You. ... Only It can be ordered. Only when things turn from our You into It, can they be coordinated. The You does not know any coordinate system. But... ordered world is not the world order. There are moments of quiet ground, during which world order becomes manifest, as presence. In these moments a sound flies past, a sound born from the unrecognizable music scripts of an ordered world. These moments are eternal, these are the most fleeting: no content can be retained from them, but their strength flows into the creation and into human knowing, rays of their strength infiltrate the ordered world and dissolve her over and over again [Own translation of German text¹].

¹ "Der Mensch wird am Du zum Ich...Nur Es kann geordnet werden. Erst indem die Dinge aus unsrem Du zu unsrem Es werden, werden sie koordinierbar. Das Du kennt kein Koordinatensystem. Aber ... Geordnete Welt ist nicht die Weltordnung. Es gibt Augenblicke des verschwiegenen Grundes, in denen Weltordnung geschaut wird, als Gegenwart. Da wird im Flug der Ton vernommen, dessen undeutbares Notenbild die geordnete Welt ist. Diese Augenblicke sind unsterblich, diese sind die vergänglichsten: kein Inhalt kann aus ihnen bewahrt werden, aber ihre Kraft geht in die Schoepfung und in die Erkenntniss des Menschen ein, Strahlen ihrer Kraft dringen in die geordnete Welt und schmelzen sie wieder und wieder auf" (Martin Buber, "Ich und Du," 1995, p. 28-31).

1. Introduction: Framing the research questions

In 2007, I decided to apply for one of the PhD positions in an integrated research program funded by the Netherlands Organization for Scientific Research – Science for Global Development (NWO-Wotro). I knew my way around urban geography and Geographic Information Systems (GIS), but I had merely an inkling of what Spatial Data Infrastructure (SDI) entails. My contribution to the research program included exploring how SDI can be used in urban governance networks to tackle poverty in Indian cities.

I asked among colleagues working as GIS analysts in government and private industry in Colorado, U.S.A, the place where I was working and a place with a sizeable GIS user community. It turned out they also had only a rather vague idea.

In that same year, the GIS community in India was celebrating the 6th anniversary of the Indian “National SDI: Strategy and Action Plan” adopted in 2001 at the 1st International SDI workshop in Delhi. But during extensive fieldwork later I could not identify researchable traces of the National SDI in the Indian cities included in the research program. Instead, I found tentacles of the national SDI initiative in the work of state-level Spatial Data Centres of the Indian Department of Science and Technology (DST). However, this work involved rural issues and was for the most part separate from urban administrative work. When I talked to an official in charge of the Karnataka State SDI the conversation resembled the ones in Colorado, and I am paraphrasing: *The term SDI means something to people in chairs in Mumbai and Delhi, but on the ground, nobody uses it. We have been working in GIS since the 1980s, but when we first started working on SDI, we all had to look up what it means.*

With respect to the Indian cities included in our research program, I similarly wondered, in what shape and form is SDI there? Where does it start and end – organizationally, geographically, and temporarily? And, what I think endowed this research with a special twist, I asked, indeed needed to ask: what else is there and how does it compare to the (future) visions of developing SDI in administrative work in Indian cities?

After a pilot study in the city of Mugdali² (Karnataka) in 2008 and upon return to my office in Enschede, I delved into information infrastructure theory. Initially I stayed clear of books and articles on political and

² This is a fictitious city name. I will explain the reason in section 2 of the thesis.

administrative science³, although the latter would later appear on my desk. After all, if I was going to search for SDI, I needed to first know what I was looking for. I began to sketch out the core tenets of SDI and read up on what was already known at that time about how SDI is shaping up in different places across the globe.

Thus SDI as a general topic and magic concept guided this inductive research endeavour. As a concept, SDI helped me to set agendas incrementally and provided a vocabulary for debate in workshops and meetings. It helped me integrate the different things I saw and heard, the questions I asked, and the conclusions I drew. Where did the magic concept lead me as I forced my way into crowded busses or waited for entry to Commissioners' offices in Indian cities? It took me from one GIS project under implementation to the next and into a sea of paper work. While the concept of SDI guided my study, GIS implementation and paper work were empirically prevalent. That is why the terms "paper list" and "GIS map" made it into the final title of the thesis.

This is an opportune moment in the text to sneak in an ontological note. "Digital transformation" in the title not only refers to (potential) digital transformations of the processes in the realm of urban land administration and poverty alleviation schemes in India, described in this study. It also refers to the digital transformations that the things, people, and activities I encountered, have undergone as I digitized my field notes and thoughts on a laptop during Indian evenings and from there via computer screens in Europe eventually onto the pages in front of you. Along the line of constructionism (Bryman, 2012), this means that what I call my "descriptions", for the sake of simplicity and legibility, are the outcome of transformations between moments of encounters "out there" and the text in front of the reader⁴. In other words, I have "chutnified time" – each section of the text a jar of pickles although far, far away from the poetic and eloquent spiciness of those pickled up by the main character in Salman Rushdie's "Midnight's Children" but, like the character, I need to acknowledge that in both methods - pickling and writing - some "distortions are inevitable."

For the sake of legibility, ordering the research process involves striving towards a classificatory system (Mol and Law, 2002). The thesis contains

³ My use of political and administrative science terminology is informed by the literature I refer to in a given text passage and by the vocabulary and distinctions made by research participants and respondents in India. These terms are thus to some degree "empirically defined."

⁴ The same goes for "representations" when I write about maps or lists, for instance, as "representations." From the epistemological perspective underlying this research, it would be more appropriate to write "re-presentation." However, I gloss over these stylistic nuances. The space between adjacent letters, previously occupied by a dash, has been deleted in the name of legibility.

three main parts, each with sections and sub-sections. The logic and content behind this structure are as follows.

The research questions connect three main aspects of this study: the global literature on SDI, the Indian (urban) context, and the broader conceptual literature. The questions were formulated in an ongoing conversation between these three aspects and resulted in four publications over time. The structure of the thesis reflects this conversation as far as possible.

In *part one* (sections 1 to 3), the longest part of the thesis, I address each of these aspects in turn. In section 1, I describe the research agenda built around the concept of SDI as it arose from reviews of existing SDI research and literature. I identify the main research aims and translate these into more concrete research questions with reference to the Indian urban context. Section 2 addresses the second aspect, the empirical context, in more detail. After sketching out the process of fieldwork, a multi-site ethnography, I provide an overview of the Indian NSDI as a backdrop to the urban scene, which is characterized by a multiplicity of e-government projects, on one hand, and administrative paper work, on the other, in the state of Karnataka. I also elaborate on several government improvement schemes that were being implemented during the time of fieldwork. In section 3, I discuss the conceptual literature, the third aspect connecting research questions and aims. I describe the process of interpretation across research questions and elucidate the main theoretical concepts that informed my interpretations.

Part two of the thesis (sections 4.0 to 4.3) may be thought of as a drawer containing "circumstantial evidence." It includes the publications (three research articles and one book chapter) sorted by research question. Each publication provides a detailed account of the research process. I begin with the development of my research perspective (section 4.0) and answer the first three research questions (sections 4.1 – 4.3).

Part three (sections 5 and 6) is the last in the thesis. In this part, I go beyond summarizing the findings in Part II. Instead, in section 5.1, I *synthesize* answers to the research questions. Based on this synthesis, I address in section 5.2 the fourth and final research question discussing possible implications of SDI development in urban governance. Finally, in section 6, I outline future research directions and implications for SDI development and practice. The terminology I used in the publications in part II differs slightly from the terminology in parts I and III. The reason is that parts I and III, were written after part II and constitute a meta-interpretation of the entire research process, that goes beyond the individual publications.

1.1 SDI as a magic concept

The origin of the term “spatial data infrastructure” can be traced back to a report by the national research council (NRC) of the United States (1990). In this foundational report, the term “spatial data infrastructure” featured undefined amongst a host of synonyms – “geographic data infrastructure”, “geographic information infrastructure”, “mapping infrastructure”. In 1991, Professor John McLaughlin chose “spatial data infrastructure” and defined it at a national level in two influential speeches (1991a, 1991b). In 1994, “spatial data infrastructure” was canonized with the publication of Executive Order 12906, titled “Coordinating Geographic Data Acquisition and Access: the National Spatial Data Infrastructure (NSDI)”, and signed by President Clinton.

In the following years, SDI, now fixed as a name and as an account of desirable intra-government practices to share and reuse digital spatial data, travelled across the world (Homburg & Georgiadou, 2009). In Europe, the U.S. American initiative found its pendant in the Infrastructure for Spatial Information in the European Community (INSPIRE) established in 2007 to foster the development of national SDIs of the member states. In Africa, 16 countries advanced SDI initiatives between 2005 and 2006 (Lance & Bassolé, 2006). India initiated NSDI in 2001 when a task force was set up to prepare a viable strategy and action plan (DST, 2001). The Global Spatial Data Infrastructure (GSDI) association now publishes regular newsletters on SDI developments in the Latin-American and Caribbean region, the Asian and Pacific regions, Africa, Europe and North America.

SDI as a name has travelled without much friction across the globe (Czarniawska and Sevón, 2005). In the past 25 years, SDI as a *name* has appeared in official policy documents of national and international organizations, in titles of research projects, in labels of academic curricula, in the names of research units, academic departments and chairs, in the names of journals and academic articles, names of conferences, seminars and workshops, exhibitions, associations, and titles of grant applications. Researchers, much like in our own program, have applied the SDI label to diverse spatial data sharing initiatives across various domains and scales, including efforts in municipal government to implement Geographic Information Systems (GIS) (Turkstra, Amemiya, & Murgia, 2003; Vries de, 2006) or SDI development for specific application domains like poverty alleviation and natural disaster management (Akinyemi, 2007; Asante, Verdin, Crane, Tokar, & Rowland, 2007).

SDI as an *account of desirable intra-government practices* to share and reuse digital spatial data travelled with somewhat more friction. Conceptual

frameworks and guidelines for the development and evaluation of SDI (implicitly) assume a relative homogeneity of people as well as of their rationales and practices across the globe and through time. And SDI is expected to be a globally homogeneous outcome of linear processes. In a review of SDI initiatives in Asia, Pacific, European, and North American regions, Rajabifard et al. (Rajabifard, 2008; Rajabifard, Binns, Masser, & Williamson, 2006) found “different paths that can be followed in the creation of an SDI” (p. 733). Nevertheless, the authors argued that “the process of SDI development is continuously evolving with a continuum of development across all countries [where] most countries are at some stage of the continuum” (p. 736).

The discourse of a homogenous and converging SDI fuels the travels of SDI across the globe in an effort to reach agreements on approaches to design and evaluation. It offers technical tools and methods for specific purposes. Standardized frameworks, assessment indicators, and SDI cookbooks provide a basis for initial comparisons at national and cross-national scales and offer blue prints for formal organizations, government, citizens, and researchers to communicate about SDI as the number of initiatives around the world is growing. To engage in translating the SDI project from one place to another necessitates not only coming to grips with the presence and staging of a certain level of agreement on an objective, culture- and place-independent reality, but also bringing about some appearance of order and predictability into preparing for what is always disorderly and uncertain, namely the future (Czarniawska & Sevón, 2005; Rottenburg, 2005).

SDI in this sense functions as a magic concept, a myth, a fashion or a metacode (Czarniawska & Sevón, 2005; Georgiadou and Homburg, 2009; Homburg, 2008; Pollitt & Hupe, 2011; Rottenburg, 2002; 2005). Magic concepts are so normatively-charged it is hard to be against them. They have a daunting breadth of scope and are often clustered together in the same phrase to mutually reinforce their positive connotation. Magic concepts are useful, because they help to set agendas and provide a vocabulary for debate. They can integrate human behavior in a sensible way, being a source of inspiration that experts, politicians and other stakeholders can use to enact social reality.

The conceptualization of SDI runs precisely on the simplistic assumption that SDI can be universally understood and translated into practice. But dismissing the universalistic assumption as naïve would be a disservice to the SDI project. Without SDI as a magic concept we would not be motivated to translate at all and would refrain from circulating SDI-related ideas, artefacts and practices (Czarniawska & Sevón, 2005). With SDI as a powerful narrative

we are inspired to work towards its realization or to explore, as this study does, how it is being realized.

Thus, it is no surprise that a single standard definition of what SDI is or should be remains elusive. As a magic concept SDI has been deployed broadly in the literature to capture different initiatives, including those that were not explicitly labelled as such. At the same time, SDI discourse is ripe with promises of societal and environmental benefits that may be achieved through successful SDI development. It is because of its vagueness and yet general agreement on its usefulness and “goodness” within the geographic community that the concept so effortlessly crosses boundaries and could travel from the U.S.A. to India – two vastly different institutional settings - in a few years’ time.

While we can acknowledge that SDI is not precise or even stable, we need to position the concept historically. SDI is normatively attractive and “hard to oppose” (who would not want more data sharing, and access to spatial information?), but as a magic concept “needs to be ‘filled’ with a good helping of contextual and cultural details before it can be operationalized” and serve explanatory functions in systematic ways (Pollitt & Hupe, 2011, p. 649).

First, SDI did not just fall from the skies. It has a historical pedigree. It is possible to trace the historical roots that have and continue to inform SDI’s core tenets. The aim of the following section is to identify the approximate coordinates that delineate the perimeter of the SDI concept as a necessary first step on the route to Indian NSDI and Indian cities.

1.2 Historical roots and core tenets of SDI

The SDI concept is inextricably linked to government, digital spatial technologies and spatial data, as well as to the rise of the internet.

Government at all levels—national, state-level and local—needs data in order to govern, or as James C. Scott (1998) would have it, the state⁵ needs data in order to know its society and territory. Government uses spatial data in legislative and policy development, for the allocation and management of natural resources, for defense and public safety purposes, in support of a variety of regulatory activities, for spatial planning and for promoting a better

⁵ In parts one and three of the thesis when I write “the state” I refer to the meaning of state in James Scott’s work (1998). When I write “state-level” or “state-wide” it is in reference to the hierarchy of jurisdictional divisions in the federal constitutional Republic of India, which consists of 28 states and 7 union territories. My empirical sites were cities in two of these Indian states, the state of Karnataka and the state of Maharashtra.

understanding of the physical, economic and human geography of a nation. Specialist government agencies—National Mapping Agencies, Cadastres, Statistics, Forest, Soil, Hydrographic, Geological Surveys and Land Affairs, and Spatial Planning departments—around the world, have long traditions in the collection of spatial data. Each agency employs specialists to organize the collection, updating and management of the type of spatial data for which it is responsible. In the past, the process of collection was expensive and laborious, performed with ground-based methods. The updating cycles often spanned several years and the outcome (paper maps) could not be easily shared across government agencies. The potential for integration and multiple applications of spatial data could not be exploited.

The advent of digital spatial technologies has changed this state of affairs. Spatial data are referenced to a global geodetically defined coordinate system. The outcome is digital ortho-photo maps, satellite image maps, topographic maps, thematic maps, e.g. land-use maps, and land-use change statistics. With *Geographic Information Systems (GIS)* it is easy to correlate and integrate these different spatial datasets and gain new insights into the interaction of geographic phenomena. A condition for integration is that the data must be collected and spatially referenced in a consistent way. This is possible with the *Global Positioning System (GPS)* and related global satellite positioning technologies, now known collectively as *Global Navigation Satellite System (GNSS)*, as well as real time and web-based mapping systems (Dodge, Kitchin, & Perkins, 2011b; Corson & Palka, 2004). Further, spatial data collection by sensors mounted on aircraft or on remote sensing satellites or in-situ, a process called *Earth Observation (EO)*, allows spatial scientists to observe and monitor complex and dynamic earth processes, unfolding over space and time, and crossing national boundaries.

In the SDI concept, at least four historical trends converge (and these are by no means intended to be exhaustive): *the alliance between government and the development and use of new spatial technologies, the rise of the e-government paradigm along with the internet as a popular medium to integrate administrative processes and data to increase efficiency, and provide access to the data and services to non-governmental actors, as well as new possibilities of gathering from and disseminating data to non-government actors, for instance through new Web2.0 technologies.* Similar historical trends are observable in countries and regions outside of the U.S.A. In India, for instance, the Survey of India (SoI), now under the Department of Science and Technology (DST), has centuries of experience and skills in topographic mapping of India, and plays a leading role in the Indian NSDI. However, in the following discussion, the focus will be mainly on the U.S.A., because this is where SDI first appeared in name.

Alliance between government and the development and use of new spatial technologies:

In the U.S.A. the alliance between government and spatial technologies, that now form the underpinnings of SDI, arose during the 20th century. The link between government and spatial technologies is embedded in the history of the U.S.A.'s foreign policy, political events, and advances in technology for military purposes, on one hand, and the disciplines of geography and cartography, on the other (Shelley, Bigler, & Aspinall, 2004; Corson * Palka, 2004; Monmonier, 2011). Large numbers of geographers and cartographers were employed for military services during World Wars I and II, the Cold War, and again in the post-9/11 period (Shelley et al., 2004). Many spatial technologies, specifically earth observation and GPS, have their origin in military applications and were later deployed for civilian planning.

In some cases spatial technologies and methods for data collection were first developed for civilian planning. For example, one of the first large-scale federal programs to deploy remote sensing methods during the New Deal Era was in agriculture. The U.S. Department of Agriculture (USDA) used aerial photography to survey planted acreages, and it was after the beginning of World War II that the accumulated expertise from a civilian practice was applied to collecting military intelligence (Shelley et al., 2004).

GIS development and use in government and research found special impetus from a U.S.American federal government effort: the establishment of the National Center for Geographic Information and Analysis (NCGIA) in 1988 (Shelley et al., 2004; Sui & Morrill, 2004). While the federal government had been funding geographic research on an ongoing basis in the past, the NCGIA specifically promoted research in spatial analysis and statistics, spatial relationships and database structures, artificial intelligence and visualization of spatial data as well as social, economic, and institutional aspects related to GIS technology (Shelley et al., 2004).

Although the origins of GIS are elusive (Harvey & Chrisman, 2004), GIS development followed the digitization and computerization in the discipline of cartography (Dodge, Kitchin & Perkins, 2011b; Muehrcke, 1990). Tobler's 1959 paper on the potential role of computing in cartographic practices counts as a seminal publication from this era (Dodge, Kitchin, & Perkins, 2011a). Similar to SDI, various definitions have been proposed over time for GIS. Some emphasize a linear sequence of procedures; some include people and social arrangements; others regard GIS as a tool, as content and as both tool and content (Chrisman, 1999). Table 1.2.1 summarizes GIS definitions and the elements they emphasized over time.

Geographers became increasingly involved with GIS, a trend that not only induced a “quantitative and positivist revolution” in the discipline itself⁶, but also produced hundreds of graduates employed in the GIS sector of government (Shelley et al., 2004; Wilbanks, 2004).

Table 1.2.1 GIS definitions and characteristics. Adapted from Chrisman (1999)

A Geographic Information System is...	Characteristic
“...a system for capturing, storing, checking, manipulating, analysing and displaying data which are spatially referenced to the Earth” (Department of the Environment 1987, p. 132)	Emphasis on linear sequence of procedures
“...a system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth” (Dueker and Kjerne 1989, p 7-8)	Inclusion of social actors and structures, distinguishes data from information
“...an information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially-referenced data, as well as a set of operations for working with the data (Star and Estes 1990, p 2-3)	System as content and operations
“...a computer-based tool for mapping and analyzing things that exist and events that happen on Earth” (ESRI 1997)	System as tool
“...any system capable of coping with georeferenced data and permitting some form of geospatial selection or query” Rhind (1996, p 3)	System as content and tool
“...an organized activity by which people measure and represent geographic phenomena then transform these representations into other forms while interacting with social structures” (Chrisman, 1999, p 175)	System as social activity reflecting and influencing the larger social context.

Integration of administrative processes and data to increase efficiency under the rise of e-government paradigm and internet:

⁶ In the early 1990s, a productive debate flared up between human and physical geographers. Human geographers were concerned that GIS served large corporations, public agencies and governments while eschewing the disenfranchised (Schuurman, 2009). They lamented the emphasis on systems engineering rather than on people, GIS’s role in surveillance and societal control and the general inaccessibility to those without high levels of technical skills. Eventually, these critiques stimulated reflection on the role of technology and its social responsibilities. At the same time, some geographers argued that the ‘S’ in GIS should stand for ‘Science’ not for ‘System’ (Goodchild, 1992; 1995). A shift of focus to ‘Science’, they argued, would remove the isolation between the traditional spatial disciplines, like geography, and computer science. Nowadays, a genuine desire is evident on the part of critics and GIS practitioners to ensure responsible GIS use at both the application and algorithmic level in GIScience (Schuurman, 2009).

Increasing spatial data processing capacities and the rise of the internet during the 1980s were accompanied by an increasing “flood of data” available from satellite images and aerial photographs from Cold War reconnaissance, made available to public and civilian use in 1995 (Wilbanks, 2004; Shelley et al., 2004; Sui & Morrill, 2004). At the same time the “array of potentials from ever increasing amounts of digital spatial data raised fundamental issues about selective supply and use of data, protocols for condensation of data, storage of and access to data, and more importantly how to make sense of the data” (Wilbanks, 2004, p. 12).

The concept of SDI emerged in the 1990s when spatial and communication technologies, especially the Internet, moved the emphasis from stand-alone GIS towards networked systems and information infrastructures (Nedović-Budić, Crompvoets, & Georgiadou, 2011a, p. xi).

The emphasis on integration in SDI is closely related to earlier calls for integration in GIScience (before SDI was born in name). For instance, in a 1990 article Muehrcke called for the need to integrate GIS technologies to tackle environmental issues and predicted high demand for experts in the integration of geoprocessing technology (Muehrcke, 1990). Nine years later Goodchild lamented that “one of the greatest impediments to effective use of geographic data has been the inability to integrate information about a place,” specifically referring to the fragmentation of data and map production across different government programs (1999, p.5).

In GIScience, technical integration can be described as “a high degree of interconnection between two or more programs or datasets, in which a common schema, ontology, semantic approach, or method is shared that allows information to be passed between them without being fully processed” (Wade & Sommer 2006, p. 109). It refers to database integration (Devogele, Parent, & Spaccapietra, 1998), technical means of combining spatial data from different repositories (Abel, Ooi, Tan, & Tan, 1998; Bittner, Donnelly, & Smith, 2009; Petit & Lambin, 2001), integration of methods and models (Kjenstad 2006; Taylor, Walker, & Abel, 1999; Yang et al., 2005), categories and classifications (Ahlqvist, Koukbir, & Oukbir, 2003; Kavouras & Kokla, 2002), and integrating GIS with other systems and applications (Huang et al. 2001; Li & Yeh, 2000; Liu, Li, Tan, & Chen, 2011). In SDI literature technical integration is addressed through interoperability of different data, processes and applications, semantic integration (Mohammadi et al., 2010), web-based integration mechanisms (Li, Yang, Wu, Li, & Miao, 2010; Maué 2008; Vaccari, Shvaiko, & Marchese, 2009; Zhang, Zhao, Li, & Osleeb, 2010) and development of technical standards (Atkinson, Millard, & Arctur, 2007; Maué, Stasch, Athanasopoulos, & Gerharz, 2011). In organizational terms, SDI is concerned with integration through inter- and intra-organizational

coordination, collaboration, and cooperation to foster spatial data sharing and access (Budhathoki & Nedović-Budić, 2007; Olsson 2009). It relates to streamlining processes through standardization with respect to data sharing and access policy and legal frameworks (Janssen, 2007; 2008), while also considering the characteristics and context of an individual organization (Harvey and Tulloch, 2006; Nedović-Budić, Pinto, & Warnecke, 2004; Omran, 2007; van Loenen & van Rij, 2008).

In SDI literature issues and problems of data sharing and interoperability of datasets and systems take center stage. While the technical challenges of SDI development remain large, data sharing problems also stem from “the unique socio-political positions, capacities, epistemologies of [...] data users” (Elwood, 2007), practices and related data classifications of different governmental organizations (Schuurman & Leszczynski, 2006), differences in the perception of benefits of data sharing in inter-organizational GIS development (Nedović-Budić, Pinto, & Budhathoki, 2008), and legal issues related to data licensing (Onsrud, Campbell, & van Loenen, 2010). Furthermore, data sharing behavior is influenced by social norms, cultural context and social network position of individuals within an organization (Omran, 2007; Wehn de Montalvo, 2003).

The emphasis on data sharing and integration in SDI conceptualizations and development is reminiscent to notions behind the electronic government paradigm more broadly. SDI’s appearance lines up historically with the rise of the e-government paradigm. Computerization efforts started in the U.S.A. in the 1950s for the purpose of increasing the efficiency and control of administration⁷ (Starr, 2010). When the internet became a popular medium in the U.S.A., the Reagan era’s “vision of a reinvented state increasingly emphasized the use of online communication in making government more customer friendly” (Starr, 2010, p.4). An important event in the course of e-government related reforms was the “Reengineering through Information Technology” vision of the Clinton-Gore era to remove barriers of time and

⁷ In (later) cases, where I do not refer to specific sources from the literature, I use “administration” as activities that comprise the implementation of regulations, law, and programs of the government. Especially in later sections “administration” and “administrator” are also empirically defined from my research in Indian context. The terms gained mainly three (partially overlapping) meanings during fieldwork and interpretation: a) people referred to me as ‘administrators’; b) people who are members of the Indian *Administrative Service* (IAS), c) in juxtaposition to politicians: those people, who are working for the government in planning and program implementation, but who are not publicly elected officials with emphasis on administrators being held accountable by elected officials. In later sections, I also use the word “bureaucracy/bureaucrat,” but only with reference to specific authors, who use this terminology. In these cases “bureaucracy/ bureaucrat” are taken as synonyms of “administration/administrator.”

distance in 1993 (Homburg, 2008). Clinton's executive order to establish NSDI followed only one year later, in 1994.

In the early days of e-government, "governments regarded ICT [Information and Communication Technologies] primarily as a tool for streamlining their own (internal) organisation and processes, in particular with respect to policy implementation" (Prins, Broeders, & Griffioen, 2012, p. 2). Later, the emphasis gradually shifted from internal organization to the "outside" that is to effective and efficient service delivery to citizens and businesses based on a view of ICT as a politically neutral tool that would support government to work faster and in a more integrated manner (Homburg, 2008; Prins et al., 2012).

E-government seeks to improve and renew government through intra-government cooperation and to transform government into a technically enabled, seamless apparatus (Homburg, 2008). The lack of standardization and interoperability between ICT systems, databases, and data as well as the lack of cooperation in back offices of government and conflicting interests and competences turn out to be major perceived and actual problems to implementation (Homburg, 2008). E-Government aspires to more efficient administration through information sharing and integration within government.

These influences of the e-government paradigm are reflected in global SDI discourse. Global SDI discourse has promoted integration in technical and organizational terms since its inception when the U.S.A. national research council (NRC) recommended that "policies, strategies, and organizational structure should be established for the integration of national spatial data collection, use, and distribution" (Masser, 2009, p. 219). In GSDI conferences reference to integration and its synonyms - seamlessness, convergence, harmonization, and bridging - is ubiquitous (for instance in van Loenen, Besemer, & Zevenbergen 2009).

With SDI framed as a necessary goal not only for intra-government integration and efficiency but also as a basis to provide access to spatial data and related technologies, authors have often prescribed the development of SDI, thus breaking new ground for research and societal practice. Publications include Groot and McLaughlin's "Geospatial Data Infrastructure: Concepts, Cases and Good Practice" (2000), Masser's "GIS Worlds - Creating Spatial Data Infrastructures" (2005), and Nebert's "Developing spatial data infrastructures: The SDI Cookbook" (2004) among others. These development prescriptions and guidelines contributed to an approximate outline of the SDI - what it generally is, can or should be. Besides guidelines for the development of SDI, there is also an EcoGeoCookbook for the

assessment of the value of geographic information (Genovese, Roche, Caron, & Feick, 2010).

Substantial research has been conducted on technical and engineering aspects of SDI development, including standardization, access, transfer, and representation of spatial data, as well as on policy, organizational, and implementation issues, especially with respect to data sharing and coordination (Nedović-Budić, et al. 2011a, p. xiii). The three main areas underpinning SDIs are coordinated policy and organization, interoperability and sharing as backbone of SDI, but also the discovery, access and use of spatial data as main purpose of SDIs (Budhathoki & Nedović-Budić, 2007, drawing on definition by Masser, 2005).

Government providing access to data and services to non-governmental actors:

The importance of access and use of spatial data does not only refer to governmental users, but also citizens, citizen associations, and private industry. SDI related technologies, institutional arrangements, and practices are meant to support the disclosure and sharing of spatial data among various levels of government, citizens, and corporations (Homburg and Georgiadou, 2009). For e-government, Bekkers and Homburg (2005) identified several types of services provided by the government to non-government (where citizens are conceived of mainly as consumers) on the basis of ICT use: information services, contact services, transaction services, participation services, and data transfer services.

In SDI the emphasis rests on data transfer services, which refer to the exchange and sharing of spatial data between government agencies and between government and private organizations. In SDI the aim is to provide access not only to spatial data itself, but also to metadata (descriptions about quality, content, and sources of a spatial dataset), online mapping services, and related technologies. Most indicative is the increasing number of online clearinghouses and geoportals around the world (Crompvoets & Bregt, 2003; 2007; Maguire & Longley, 2005). Latest estimates suggest that 105 countries have national spatial clearinghouses, an increase of nearly 25% between 2006 and 2011 (Nedović-Budić, et al., 2011a, p. xii).

As such the core tenets of SDI reflect a “managerial” e-government model of government-citizen interaction, in Chadwick’s and May’s (2003) terminology. Here the focus is on administrative reform for more efficient service delivery to citizens, where technology supports an integrated administration to deliver services (and in case of SDI spatial data for further use) uni-directionally to a target population, for instance through internet-based one-stop shops.

While one approach to e-government “seeks to make administration more citizen-oriented, another goes further and seeks to bring administration closer to the citizen through increasing the participation of citizens in the political and public debate” (Homburg, 2008, p. 90). It is mainly in the latter respect that SDI generally deviates from e-government. SDI development seeks to address the perceived cleavage between government and citizen *directly* by making data and spatial technologies accessible to people, for instance through clearinghouses, and to improve social and environmental well-being and service delivery through more efficient government and planning. This was emphasized in the first NSDI initiative under the Clinton Administration, which focused on both intra-government information integration and sharing to increase government efficiency, and on open access to this information to public users (Onsrud, 1992, 1998a).

The ultimate objectives of SDI development are to promote economic development, stimulate better cooperation and government, foster environmental sustainability (Nedović-Budić, et al., 2011a, p. xii) and social well-being by means of improved – more integrated and efficient – government.

New possibilities for government to gather from and disseminate data to non-government actors:

Influences of the larger governmental and governance environment find subtle expression also in changes in SDI discourse. For instance, the conceptualization of integration in SDI, whether hierarchical or networked, followed changing notions of governance (Hood, 2000) over time. An earlier SDI model by Williamson et al. (2003) proposed integration based on a hierarchically nested administrative structure from local to national levels. Scholars now speak of networked governance in recognition of the plurality of institutional arrangements in policy making, and the state’s role in coordinating a diversity of interests, preferences and values (Madon, 2009, pp. 36-37). SDI literature emphasizes horizontal networking through SDI metaphors, such as a ‘patchwork quilt’ or as a ‘collage of similar, but often quite distinctive components’ (Masser, 2009).

It is becoming increasingly difficult to pin-point SDI nowadays. For one thing, SDI now also includes the integration of citizen-generated data. The notion of citizens as “voluntary sensors” has gained considerable popularity within SDI publication outlets, for example in the International Journal of Spatial Data Infrastructure. Especially since the onset of Web 2.0 technologies, mobile technologies equipped with location tracking devices and data available from social network sites have spurred interest in leveraging information provided

by or potentially retrieved from citizens also in the SDI community (Coleman, Georgiadou, & Labonte, 2009; Diaz et al., 2012; Goodchild, 2007; Georgiadou, Budhathoki, & Nedovic-Budic, 2011). The notion of citizen sensors is less concerned with people's participation in government planning, policy, and decision making or in the sense of holding government accountable with respect to its performance by use of ICT. Rather it refers to "citizens" as data providers to the government. In this sense, it is the flip side of information flows: the "citizen" not as consumer (of government data and services), but as provider (of mainly information). While SDI related research in this field focuses on data quality, trustworthiness, and technical solutions to integrate such information in government databases, privacy concerns have also been addressed in studies on citizen provided information (Ooijen & Nouwt, 2009).

The meaning of "data access" is also taking on a new and arguably more complex form in a regime of ICT based information flows going to as well as from government. Notions of government transparency (Fenster, 2006, 2012) interlink with concerns of citizen privacy and surveillance (Prins et al., 2012; Stalder, 2011). Participation in government policy and decision making combined with the ability to hold government accountable (Bovens, 2007) needs to be differentiated from participation in the sense of merely enabling information input to government online (Johnson & Sieber, 2011).

Many of these aspects of a changing e-government paradigm are more or less captured under the new and as yet ill-defined concept of "open government", which gained global momentum after President Obama's "open government data" (OGD) initiative (Meijer, Curtin, & Hillebrandt, 2012). The initiative calls for transparent, participatory, and collaborative government (Obama Memorandum, 2009). OGD initiatives around the globe entail the active release by government of raw, machine-readable, high-value information in open formats. High-value information is defined as *"information that can be used to increase agency accountability and responsiveness; improve public knowledge of the agency and its operations; further the core mission of the agency; create economic opportunity; or respond to need and demand as identified through public consultation"* (Memorandum OMB 2009, p. 7). OGD initiatives take a laissez-faire approach. Government passes on to individual agencies the responsibility of making open government plans and deciding on the data to be released. Agencies thus have the discretion to decide which previously unpublished 'high-value' raw data they can place on a national Data.gov site (Georgiadou, Lungo, & Richter, 2013).

The new imperative of openness exerts a subtle influence already on the concept of SDI. The U.S.A. geoportal, the national clearinghouse of the NSDI,

can now be accessed via a link from the OGD website (<http://www.data.gov/>). The link to government transparency had previously been made by Onsrud (1992, 1998a) in the 1990s, when he referred explicitly to the U.S.A. Freedom of Information (FOI) Act and Open Records laws. Nowadays, OGD and government transparency initiatives are becoming increasingly popular among policy makers and have started their march across the globe (Meijer, Curtin, & Hillebrandt, 2012; for India see Wright, Abraham, & Shah, 2010). The ambiguity and ostensible political neutrality of transparency (in other words, appearing to be beyond specific ideologies or interests) qualify transparency for membership in the “magic concepts” club (Pollitt & Hupe, 2011). It remains to be seen whether transparency initiatives will eclipse SDI in popularity and magicness. The core tenets of SDI’s role in governance are summarized in table 1.2.1 alongside their historical roots.

Table 1.2.1: Historical roots of SDI’s core tenets

Historical roots of SDI’s core tenets	Core tenets of SDI
Alliance between government and the development and use of new spatial technologies	Government collects, processes and disseminates spatial data through spatial technologies, e.g. GIS, GPS, spatial databases, and RS
Integration of administrative processes and data to increase efficiency under the rise of e-government paradigm and internet	Intra-government integration in technical and social terms, the latter for example through coordination and emphasis on spatial data sharing in government
Government providing access to data and services to non-governmental actors	Online access to spatial data and technologies to a variety of users, including citizens, other non-governmental users, private industry
New possibilities for government to gather from and disseminate data to non-government actors	Incorporation of citizen-generated spatial data, dissemination of large amounts of data to citizens and private industry online.

As a result, SDI development, at the time of writing this introductory section, stretches somewhat awkwardly between two opposing forces. On one hand, SDI is indicative of a data hungry state apparatus with the need to accumulate, integrate and streamline information, related technologies, and organizations for more effective planning, service delivery, and national security. On the other hand, it is tied into the notion of releasing data, opening up spatial technologies, and providing access to the same to non-governmental users and uses. This tension finds a poignant expression precisely in the paradoxes and ambiguities of the following quote from the document “Indian NSDI – A Passionate Saga” regarding the role of SDI development:

“Thus NSDI supports and advances the building of a National Spatial Data Infrastructure, consistent with national security, national defence, national

intelligence, and international trade requirements. A virtual infrastructure ... NSDI facilitates the flow of spatial information from data producer to a vast and ever growing community of users in response to their needs” (Kumar, 2009, p. 53).

When SDI was born under the Presidency of Bill Clinton, the underpinning basis for SDI (digital spatial data, related technologies and widespread use of the internet) was relatively well-established in U.S. American government and in Europe. The core tenets of SDI derive mainly from North American policy and agendas, and have taken their course across the world from there.

While we may find a confluence of old and new ideas surrounding the concept of SDI in policy and academic discourse from a global perspective, the actualities of implementing SDI differ widely from place to place, and their trajectories are influenced by the existing institutions and practices that constitute different localities. In turn, “the concept of SDI becomes fragmented because SDIs evolve organically with existing organizational patterns, [as] the myth of SDI mobilizes resources in a variety of contexts...” (Miscione a& Vandenbroucke, 2011, p. 225). In addition to technical and engineering challenges in SDI development, researchers have studied and assessed the development of SDI as it unfolds in different places and at various scales. This research will be discussed in the following section with the aim to identify under-researched areas.

1.3 Research perspectives on SDI development and this study’s research aims

In the following, I blend out the recent studies on volunteered geographic information (VGI) engaging Web 2.0 and mobile technologies, and focus more on past research, specifically on four extant SDI research perspectives. The boundaries between them are fuzzy and there is some overlap in terms of individual studies. Because these perspectives participate in the making of realities (Law, 2008), they are reflective of the increasing and multiple interests in the magic concept of SDI among academics, as well as the process by which academics, alongside SDI practitioners, have come to grips with the concept and filled it with substance from various angles.

The first research perspective is rather prescriptive and focusses on how to best conduct the assessment of SDI development including technical as well as social factors and indicators, often through quantitative measurements. Assessment frameworks draw upon national and cross-national initiatives and evoke SDI as a globally shared vision and highlight convergence in SDI development. The second perspective is more descriptive and explanatory. It involves qualitative as well as quantitative analysis and emphasizes

differences in SDI development and the influences of political, economic, and cultural context. Relatively less represented in research is a third perspective inspired by the Actor Network Theory (ANT) tradition. ANT studies stand out in highlighting SDI development in terms of an evolving sociotechnical network. The fourth research perspective draws on the previous, but also includes in the analysis practices of those who are outside of a given SDI initiative, and are potential SDI users and contributors. I will discuss each research perspective in turn. In my study I develop the fourth research perspective drawing on information infrastructure theory, especially the notion of an infrastructural inversion (Bowker & Star, 2000).

First research perspective: Technical and engineering challenges in SDI development are significant and are often studied separately. However, in the following discussion I will focus on research that addresses both “technical” and “social” aspects of SDI development, because “[i]mplementation of SDIs is inherently complex, for both technical and institutional reasons. Technically, SDIs are complex because they underlie as well as draw upon various technologies, including remote sensing, spatial modelling, database technology, computer networking, and geographical information systems (GIS), while catering to the demands of diverse application domains. Institutionally, tensions arise from various sources including the need for consensus on standards, for example between the federal and local agencies, ... and over the inclusion of users in the consultative processes to finalize the key components of the SDI” (Georgiadou, Bernard, & Sahay, 2006). The complex nature of SDI and the multitude of components and aspects involved have been recognized by a number of researchers who seek to assess SDI development by means of various matrixes and indexes. Authors emphasize the complexity and multitude of factors and actors involved in SDI development as one of the most difficult, but at the same time most important, characteristics of SDI to consider in the assessment.

Researchers have developed assessment frameworks based on technical as well as social factors and indicators, mostly with quantifiable measures, and applied these frameworks to assess SDI initiatives at organizational, national, or international levels. Many of these frameworks are included in “A Multi-View Framework to Assess Spatial Data Infrastructures,” edited by Cromptoets, Rajabifard, van Loenen, & Delgado Fernandez (2008) and in GSDI conference proceedings (Onsrud, 2007; van Loenen, Besemer, & Zevenbergen, 2009). First surveys of SDI initiatives and evaluation worldwide were conducted already in the late 1990s (Masser, 1999; Onsrud, 1998b). Cromptoets & Bregt (2003, 2007, 2008) developed a suitability index for spatial clearinghouses, seen as SDI proxies, and assessed 83 national clearinghouses developed between 2005 and 2008, based on characteristics, such as monthly number of visitors, frequency of web updates, and number

of search mechanisms. Delgado Fernández, Delgado Fernández, & Andrade's (2008) framework serves to measure the readiness of different countries across the world to take up SDI based on indicators such as web connectivity, availability of digital geographic data, and financial resources among others.

Perhaps the most elaborate framework is Grus et al.'s (Grus, et al., 2011, Grus, 2010; Grus, Crompvoets, & Bregt, 2008a; Grus, Crompvoets, Bregt, van Loenen, & Delgado Fernandez, 2008b; Grus, Crompvoets, & Bregt, 2007). Based on a conceptualization of SDI as a complex adaptive system, the authors identify and combine several evaluation frameworks applied in previous studies. Besides SDI's multifaceted and dynamic nature, Grus et al. recognize the problem of vaguely defined objectives for assessing SDI development efforts, and argue that the main idea of the multi-view assessment framework is to consider specifically three goals of SDI development: accountability, development, and knowledge. The authors evaluated their multi-view assessment framework through a survey of NSDI coordinators in 21 countries and later built on the framework to develop a four phase goal-oriented assessment approach. The latter operationalizes input from SDI stakeholders with respect to the most important goals and indicators used for assessment. In the case of the Dutch Spatial Data Infrastructure (GIDEON) these indicators included the number of visitors of the national georegister, availability of datasets and services, use of view and download services, level of cooperation in GIDEON, and economic indicators, such as expenditure of private sector on research and development of geo-information products and services.

Grus et al.'s assessment approach is in line with a growing recognition in the SDI research community for the need to better understand and include the point of view of SDI practitioners and stakeholders involved in development. The aim here is to "help SDI practitioners in the assessment of the extent to which specific SDI goals are being met" (Grus, et al., 2011). Geudens et al. (2009) employ multi-actor multi-criteria analysis allowing for structured and extensive participation of stakeholders, an approach which the authors apply to the case of the Flanders SDI in Belgium.

Often the focus is on national or cross-national level initiatives in the research discussed so far. This is not surprising, since explicit SDI initiatives are mostly those driven at national or cross-national levels, such as the Australian, Canadian, U.S.A., and Indian NSDI, and European INSPIRE. Grus et al. explicitly justify their choice of National SDIs for testing and further developing their framework thus: NSDIs are "easily identifiable due to the existence of a national vision, strategy and steering committees of these

SDIs. Most countries have also a spatial data clearinghouse at national level” (2010, p. 83).

An underlying motivation of the first research perspective is the search for a broadly applicable assessment guide to help implementers and policy makers in SDI. This in turn requires an explicit or implicit assumption – at least to a certain degree – of homogeneity in SDI development and a conceptualization of SDI as a complicated set of “social” and “technical” components. What emerges in this research perspective is a vision of convergence of initiatives as expressed in the introduction to the 2009 GSDI conference proceedings: “The approaches in building spatial data infrastructures within and among nations are in many respects *converging*. Not only SDIs are converging, also many developments in society stimulate convergence of SDIs” (van Loenen, Besemer, & Zevenbergen, 2009, p. 1, emphasis in original).

Second research perspective: This perspective is more descriptive and explanatory. It includes qualitative analyses aiming to understand how SDIs have been or are being developed in practice, and which contextual factors are influential in different empirical cases. On the topic of SDI assessment, researchers with this perspective have studied, if and how *practitioners themselves* evaluate the performance of their SDI initiatives across the world and have explored how indicators for assessment are being developed by (proxy) policy makers (Lance, Georgiadou, & Bregt, 2006; Vandenbroucke, Zambon, Crompvoets, & Dufourmont, 2008). A large body of research in SDI has been carried out on intra- and inter-organizational coordination and spatial data sharing behavior, motivations, and influences (Nedović-Budić, et al., 2011a, p.xiii).

The second research perspective calls into question the universality of the SDI vision and development and is more relativist. Differences across cases and places are highlighted as important aspects of SDI development. Especially differences in stakeholder perceptions on SDI find expression, not only among stakeholders of SDI at national level, but also among users regarding the utility of NSDI at regional and local government levels (Nedović-Budić et al., 2008; Puri, 2006). This research captures people’s varying perceptions of technology not as indicative of inconsistencies and failures in development, but as active shapers of the technology. SDI is viewed “through the eyes of different relevant social groups produc[ing] different descriptions—and thus different artifacts—this results in the researcher’s demonstrating the ‘interpretative flexibility’ of the artifact” (Bijker, 2010, p. 68).

Related to this are calls among researchers to shift analytical focus onto the context of SDI development. On one hand, emphasizing context implies the

recognition of differences in the places and settings, where SDIs are being developed. SDI implementation can take different paths than expected in contrast to the often implicit assumption that SDIs diffuse from continent to continent and towards increasing convergence of uniform practices (Homburg & Georgiadou, 2009).

Neglecting the context, in which SDI development is supposed to be embedded, makes it tempting to apply standard indicators of success and failure across diverse settings and situations globally, while various settings may pose different challenges and opportunities, and endow SDI with new roles and meanings. People react and respond differently to technology, learn from and adapt to technology. They may be more or less active respondents to SDI perceiving benefits differently.

On the other hand, but obviously related, context refers to multiple influences outside of the formal organizational boundaries of a given SDI initiative. This entails the importance to include political, social, economic, cultural, and institutional factors that influence SDI development (Budhathoki & Nedovic-Budic, 2007), for instance the influence of donor agencies on SDI development and geospatial policy outcomes (de Vries & Lance, 2011; Lance, Georgiadou, & Bregt, 2012).

Overall, this research perspective highlights how SDI may be perceived of and enacted differently by people in different cultural, political and social contexts. As such it also demonstrates that SDI is not a neutral technology, but "a carrier of interests and a result of political struggles" (Silva, 2007, p.30), and problematizes two gaps important to success or failure of SDI development as well as the definition of what constitutes success or failure (assessment). The first gap is between the visions of SDI (for instance among national and international designers) and the actual circumstances of adopters. The second is between "hard" rational design and "soft" political and behavioral actuality (Heeks, 2002).

Third research perspective: This perspective draws on concepts from the Actor Network Theory (ANT) tradition. Besides the influence of contextual factors on SDI development, two additional aspects move into the foreground: the evolutionary nature of SDI development and the co-shaping between technology and society. The first is important to single out, because only few studies in SDI generally highlight the nature of SDI development as a process despite Longhorn's (2008) observation that "SDIs are composed of too many disparate elements ... to ever be conveniently herded into a single block on a diagram ... Those ...who stand the best chance of implementing SDI are those who have recognized that SDI is a process." Outside of ANT-inspired research, process in SDI development has mainly been addressed

through temporal quantitative comparisons, paying attention to the changing notion of SDI through time, the changes undergone by the concept as SDI travels across countries, or to the development conceptualized as ideal phases (Bregt, Grus, Crompvoets, Castelein, & Meerkerk, 2008; Crompvoets and Bregt, 2008; Homburg & Georgiadou, 2009; Rajabifard, 2008; Rajabifard et al., 2006). In ANT-inspired research, the technology under consideration is often GIS and the government level is local, while SDI development is approached as an evolving sociotechnical network and studied by zooming into the associative behavior of technical and social actors (Câmara, Fonseca, Monteiro, & Onsrud, 2006; Davis & Fonseca, 2006; Harvey, 2001; Silva, 2007).

The third research perspective highlights the continuous co-shaping between human and non-human actors in SDI development, the agency of technology and technological artifacts, and as such the latter's non-neutrality also in socio-political terms. Here we find an aspect of SDI – specifically the GIS artifact – somewhat reminiscent of Laet's and Mol's famous Bush Pump (2000) as a "fluid actor... that brings a lot about, but its boundaries and constitution vary and its success and failure, instead of being clear-cut, are a matter of degree (p. 248), "an object that isn't too rigorously bounded, ... flexible and responsive" with agency shaping new configurations in the sociotechnical landscape (2000, p. 225).

This third perspective brings back more visibly the information technology (IT) artifact and its agency. This is especially important in places where one cannot take for granted the institutionalized, widespread use of GIS, for instance in transitional economies, as Davis & Fonseca (2006) point out. One needs to be careful, however, when equating geographic regions with the existence or non-existence of some or all of the core tenets of SDI. Although the term SDI originates in the U.S.A. and its core tenets can be traced into U.S. history, the close alliance between spatial technology and government, for example, is also evident elsewhere. Furthermore, in how far spatial technologies can be assumed as basis for SDI development is also a question of the geographic scale or administrative level; and the dichotomy "southern" versus "northern" countries or "transitional" and "non-transitional" economies needs to be treated carefully. While there may be rural county governments in the U.S. without any GIS use similar to towns in India, New Delhi, the capital city of India, has developed the Delhi State Spatial Data Infrastructure (The Hindu Business online, 2011, 10 November; Pandit, 2011, 17 October). Mohammed et al. (2013) find differences also at national level that cannot be easily categorized under "developed country" or "developing country" labels. For instance, they find that while metadata access is less "well defined" in Nigeria, it is "well defined" in Canada, Switzerland, but also in Malaysia.

By drawing attention to the technological artifact, research perspective three digs into the core tenets of SDI development and differences in implementation of individual spatial technologies, such as GIS, across geographies and administrative levels. As such it reminds of the historical roots of SDI's core tenets and at the same time shifts through the sediments of values and rationales that have become deposited into the technologies of SDI through the years. Critical GIScience has established a large body of empirical evidence that GIS and other spatial technologies carry rationales and values, in turn shaping human understanding and practice (Dodge, Kitchin, & Perkins, 2011a). Schuurman, for instance, (2005) reminds us that "politics often determine what will be recorded in the database (and what is excluded)" (p.54). This is not only relevant in theoretical terms. Rather, she argues "recognition that a GIS concept or artefact is created through social or political influences should not detract from its importance. Indeed, it should structure or instruct technical solutions" (Schuurman, 2005, p.51).

The third research approach is only a stone-throw away from information infrastructure (II) theory, which conceptualizes II as a sociotechnical network (Hanseth & Monteiro, 1998; Hanseth & Lyytinen, 2010) or large-scale classification system (Bowker, Baker, Millerand, & Ribes, 2010; Bowker 2000a; 2000b; Bowker & Star, 2000).

Fourth research perspective: This is the research perspective which I develop in this study. It is informed by II theory and inspired by research on SDI development in land administration. More specifically, I want to highlight three characteristics of this perspective, which later and in correspondence with the empirical context will be developed into research questions.

First, in this perspective SDI development is conceived of as a sociotechnical network, which evolves through time. Information here is not perceived as a free-standing item flowing between person A and person B, or organization X and Y. Information sharing does not happen in and for itself. It is always embedded in (other) government activities (Harvey and Tulloch, 2006). The fourth perspective recognizes that the meaning of information is dependent on the context of its construction as well as reception (Fenster, 2006), and that people operate within ecologies of knowledge, where information construction is specific to place and time (Poore & Chrisman, 1992). Research perspective four entails looking "closely at technologies and arrangements that, by design and by habit, tend to fade into the woodwork [...] to recognize the depths of interdependence of technical networks and standards, on the one hand, and the real work of politics and knowledge production, on the other. It foregrounds these normally invisible Lilliputian threads" (p.34). Analytically it is the *moment of emergence* of infrastructure – not only the where, but also the "when" – which gains prominence in this approach, an

important aspect, because the “history of infrastructures cannot be told independently of the work practices that they constitute or the media in which they are inscribed” (Bowker & Star, 2000; p.132).

This leads to the second characteristic of research perspective four, namely a concern with practices, interests, and actors outside of the evolving network. To explain this, we can briefly take a look at Grus et al.’s (2007, 2008a, 2008b, 2010, 2011) research again. One of the goals of SDI development identified based on GIDEON policy documents by Grus et al. is for “the government [to] use the information available for each location in its work processes and services” (2010, p. 108). Research perspective four, applied to this study, would require asking what characterizes the “work processes and services of government,” their rationales, and aims in comparison to SDI’s core tenets. Thus, perspective four includes the analysis of the practices of potential users or potential contributors to SDI and in how far their practices and rationales match SDI’s expectations and envisioned capabilities to support existing practice.

In their day-to-day work people are immersed in relations not only to data and technology, but also to resources, such as land, housing and water and the historical practices of managing or administering these resources. Elwood (2007) explicitly includes the differences in epistemologies of land use as a factor influencing the ability of grass-root organizations in Chicago to access municipal SDI data, epistemologies that are in turn embedded in the organizations’ practices and specific objectives. Other researchers have analyzed the negotiations that take place between the requirements of a new digital land administration system, on one hand, and historically evolved flexible practices of land tenure and the history of land conflict in the places of implementation, on the other (Harvey, 2006; Silva, 2007).

Adopting research perspective four to this study was inspired by Harvey’s (2006) and Silva’s (2007) work. Their research shows that it is the contradictions between notions of modern land administration embedded in SDI design ideals, on one hand, and the multitude and flexibilities of enacting the relations between people and land in practice as well as histories of land conflict, on the other, that takes center stage in SDI development at local administrative levels.

The relationship between people and land, and the many different ways in which this relationship can be lived, regulated, and contested are often blended out in the other three research perspectives on SDI development. For its march across the globe the magic concept of SDI had to shed these historical contingencies and the questions these may raise. In order to serve as a general frame of reference, SDI’s core tenets have to be taken for

granted to some degree alongside the rationales and values that have become deposited through time into design, use and perceptions of related spatial technologies. Land records and related data are increasingly being computerized in many countries underpinned by much the same core tenets as previously outlined for SDI, including the use of GIS, the goal of seamless integration, the use of online services to provide access to data, and reusing the data across government agencies and for a variety of purposes, including strategic planning (Dale & McLaughlin, 1999).

At this point, historical entanglements stretch even further back than the U.S. American military history. Notions about the ordering of relations between people and land that underlie SDI development find some of their antecedents in the European Renaissance and especially the period of Enlightenment, and include private, individual property ownership, legal land titling, and related cadastral mapping (Kain & Baigent, 1992; Scott, 1998). SDI may then be promoted as a solution to land contestations, frequently violent, especially in times of crisis or increasing population pressure. But it is precisely the contestations and variety in claim making that make mapping and delineating the ownership of land a highly political process and a means to exert power (Kain & Baigent, 1992).

In this way, the fourth perspective also exhibits a concern with the past vis-à-vis the future expectations for SDI development and emphasizes practices not only promoted through SDI development, but also the nature of existing practices by which land and people are delineated and classified more or less permanently.

An interrogation of the rationales and actors in practices outside of SDI is useful also from the perspective of SDI designers and implementers as it essentially entails a closer look *at the nature of claimed "obstacles" to SDI development*. Rather than seeking to address a homogeneous, undifferentiated cloud of (potential) end users or contributors, it makes sense to ask why an administrative department or agency does not want or require comprehensive digital spatial data (see for example Roy, 2003; 2009), to whom specifically spatial data and technologies could be relevant, and what shifts in practices and processes are required in order to make spatial data and technologies relevant.

The third characteristic of this research perspective is that it brings into the picture the relationships between an analysis of SDI development and specific application domains as well as the aims of various government improvement schemes. SDI does not happen in and for itself. The question is, in how far or not it supports administrative work, governance processes, or improve societal well-being more generally. Evaluating impacts of SDI

development on policy goals and society is scarce. Craglia, Pilar, Bergadà, & Ros (2008) conducted a comprehensive impact study of SDI development on cost and time savings, and the ability of citizens to access municipal information.

Finally, research perspective four calls into question and allows reflecting on possible implications of SDI development in relation to larger societal benefits and well-being. I am reluctant to call this a characteristic of the fourth research perspective as it follows – interpretively – from the three characteristics outlined above.

Table 1.3.1 summarizes the four SDI research perspectives. Each perspective is valuable in highlighting different aspects of SDI and endowing the concept with meaning.

Table 1.3.1: Research perspectives and different aspects in SDI development

Research perspectives	Aspects of SDI development highlighted
1 st - Generating assessment of SDI, mainly using quantitative indicators, mostly national and cross-national administrative levels	Convergence of SDI development across the world, complexity and linkage of multiple “social” and “technical” components
2 nd - Understanding SDI development and variation (also through qualitative analyses) at national, cross-national, and regional/local administrative levels	Differences in SDI development across the world, influenced by economic, cultural, political context and different SDI stakeholder perceptions, motivations, and behaviour
3 rd - Understanding SDI development through approaches inspired by ANT tradition, more at local and regional administrative levels	Evolving sociotechnical network influenced by economic, cultural, political context, agency and rationales embedded in technology (especially GIS), differentiated development of SDI across world and through time
4 th - Understanding SDI development “inside and outside of the network” (more at local and state-administrative levels)	SDI as sociotechnical network. SDI development varies depending on diverse, practices and application domains that exist outside of the SDI network and before SDI development. SDI development does not take place in and for itself, but to support administrative work, governance processes Provides grounds to reflect on implications of SDI development for societal well-being

Four research aims follow from the fourth research perspective, which I call the “inside and outside the network” perspective.

First, I will explore the development of SDI as sociotechnical network at local and state-level across several projects and time and to identify the problems encountered.

Second, I will explore the “outside of the network”, the actors and rationales involved in non-SDI based practices of information construction and exchange (conceptualized as classifying practices), as well as the entrenched practices of information construction and exchange that are in place before SDI hits the ground. My explicit interest in the “outside of the network” allows me to include existing practices that are not (yet) informed by the core tenets of SDI and to take a look in the opposite direction, as this quote suggests: “Magic concepts are part of a quintessentially modernist narrative of progress. While many keyboards labour to produce analyses and recommendations about how to do [magic concept] and how to smooth the workings of [magic concept], *few ask the questions which go in the opposite direction*. In what situations should we avoid [magic concept] and prefer [its opposite]; how do we know when we have too much [magic concept]; would the developing world do better to concern itself with public order and basic infrastructure than with debates about how to improve its scores for [magic concept]...?” (Pollitt & Hupe, 2011, p. 653, emphasis added) This is important methodologically in order to address the following third and fourth aims.

Third, I will compare SDI and non-SDI based practices (conceptualized as practices of legibility making) to explore in how far they each support implementation and goals of the respective government improvement schemes that they are intended to facilitate.

The fourth aim is to discuss possible implications of SDI development in urban governance that derive from an inductive process of interpretation guided by the three main aims sketched out above and based on the comparison between SDI-based and non-SDI based practices.

1.4 Formulating research questions in reference to the Indian urban context

South Asia will soon be the most populous region in the world. While being the least urbanized region globally, it counts some of the largest and fastest growing urban agglomerations promising a better life to thousands of people (Rowntree, Lewis, Price, & Wyckoff, 2012). The Indian urban landscape is characterized by rapid, albeit differential, growth in both economic terms and with respect to population; and today Indian cities are seen as nodes of innovation and change attracting high rates of foreign investment (Baud & de Wit, 2008). These trends pose many challenges to policy makers and

planners, especially concerning the provision of physical infrastructure and universal basic services (Baud & de Wit, 2009).

India's New Economic Policy in 1991 initiated economic liberalization and related projects of urban transformation. The restructuring of urban space and governance along "neoliberal" lines has been theorized from different perspectives as shifts from government to governance, as a rescaling of the state, or as "roll-back" of the state from some arenas and its "roll-out" in others (Baud & de Wit, 2008; Desai & Sanyal, 2012). In parallel to an increased interest among academics and concentrated scholarly attention on the "urban" in India (Desai & Sanyal, 2012), cities are also receiving increased attention in legal terms and as target of improvement schemes. Since the enactment of the 74th Amendment to the Indian Constitution in 1992, urban local bodies (ULBs) are responsible for service delivery and infrastructure development to citizens. Major government improvement schemes, such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and more recently Rajiv Awas Yojana (RAY) (MoHUPA, no year), target specifically cities. E-government, especially in the form of digital land administration systems, citizen e-grievance systems (Martinez, Pfeffer, & van Dijk, 2011; Ranganathan, 2012; Richter, 2011; van Teffelen & Baud, 2011), and GIS for data management of slum areas more recently under RAY are characteristic elements of neo-liberal reforms, urban renewal, and administrative decentralization efforts.

Projects and programs to institutionalize the "e" in government and governance are mushrooming across the country (see sections 2 and 4.1 for the state of Karnataka) with the promise to manage and plan cities more efficiently and in a more transparent manner (Raman & Bawa, 2011). The capacity of ICT to store, integrate, manipulate, update, and retrieve ever larger quantities of information quickly and across vast areas and distances is all the more tempting in light of the South Asian cities' fast rates of change and complexity (Madon & Sahay, 2000). A body of applied research investigates the possibilities and methods by which spatial technologies can provide more comprehensive, up-to-date, and accurate information about cities, for example data and analyses to allocate and distribute services, to identify spatial concentration and levels of deprivation, and to tackle the problems related to the formation of "informal settlements" or "slums" (Abbot, 2003; Baud, Sridharan, & K. Pfeffer 2008; Baud, Pfeffer, Sridharan, & Nainan, 2009; Joshi et al., 2002; Kohli, Sliuzas, Kerle, & Stein, 2012; Livengood & Kunte, 2012).

As a sociotechnical process the development of spatial technologies in Indian government has received attention from scholars mainly at national level (in the case of the Indian NSDI) and with focus on rural areas in terms of GIS

implementation and use for resource management, land administration and rural citizen service provision (Benjamin, Raman, & Rajan, 2007; De' 2009, Georgiadou, Puri, & Sahay 2005a; Madon, 2009; Madon & Sahay, 1997; Puri, 2006; Puri, Sahay, & Georgiadou, 2007; Puri, 2007; Puri & Sahay, 2003; 2004; Raman & Bawa, 2007).

There are at least two possible reasons for the paucity in research on SDI development as a sociotechnical process in the urban context. In India, as in many other places, explicit SDI policy and design are driven from the national level. Furthermore, the urban arena in India has only recently attracted increased scholarly attention (Baud & Witt, de, 2008; Desai & Sanyal, 2012). India's political economy has traditionally targeted agrarian issues (Durand-Lasserve & Royston, 2002), and e-government implementation as well as related research followed suit. For example, the state-level SDI in the southern state of Karnataka (an explicit SDI initiative that spun off the Indian NSDI) evolved mostly on the basis of databases developed for rural planning and natural resource management.

Thus, e-government initiatives in urban areas are only recently emerging, and may or may not be explicitly referred to as SDI initiatives by implementers and participants in the development of SDI. For SDI research this means engaging with a multitude of magic concepts criss-crossing the scene of emergent e-government, digitization and computerization efforts in order to "see the wandering nature of SDI and the ambiguity of the SDI notion as opportunity and a strength rather than a limitation" (Nedović-Budić, Cromptvoets, & Georgiadou, 2011b, p. 240). Pollitt & Hupe (2011) suggest that in light of the volatility of magic concepts, more traditional conceptual equivalents may be preferable. In the case of SDI in Indian cities, GIS implementation for master planning processes, urban property database development, and more recently the design and development of state-wide GIS to manage slum improvement schemes are such traditional but preferable conceptual equivalents.

A lot of ground remains to be explored in future research both theoretically and empirically to understand the various ways in which spatial technologies come to shape and morph into Indian urban governance. Only recently have researchers turned attention to the urban arena in Karnataka to study the processes by which spatial technologies actually become implemented in government, the actors, interests and rationales involved, as well as their socio-political implications (Raman, 2012; Ranganathan, 2012; Virkar, 2014 forthcoming; 2014a forthcoming; 2014b forthcoming). These studies mainly focus on the capital city and region of Bangalore. Regions outside of megacities have received less attention. Broadening the view to include smaller cities is relevant, because governance processes are likely to work differently

from large cities, and at the same time may change in the near future as mid- or small-sized cities are growing and increasingly come under the influence of visions and developments that characterize large cities (Desai & Sanyal, 2012).

My study focuses mainly on medium-sized cities in the southern Indian State of Karnataka. At the time of fieldwork, two government⁸ endeavours dominated the urban scene in India: the already mentioned India-wide JNNURM as well as several digital property database projects and initiatives in the area of land administration. These endeavours seek to foster efficiency, transparency, and administrative decentralization at the local administrative level through various reform tools.

JNNURM, a seven-year long national investment scheme for major cities across India, was launched in 2005 to reform urban governance. Its focus was on "efficiency in urban infrastructure and service delivery, community participation, and accountability of ULBs/Parastatal agencies towards citizens" (MoUD, no year). Implementing ICT in government played a key role to support systematized accounting, benchmarking, and performance measurements in JNNURM as well as in a similar state-wide program *Nirmala Nagara* (Clean City) (Ranganathan, 2012). GIS property mapping under *Nirmala Nagara* is the most prominent and long-term among various efforts to computerize land administration and property records for cities in Karnataka.

SDI in the urban arena is thus most manifest in the form of digital property database development. This provides the empirical background to address the first research aim to explore, SDI development as sociotechnical network, the inside the network perspective. The first research question is as follows: *How does SDI development take place in the case of digital urban property database development and what are the problems encountered?* It is addressed in section 4.1 of the thesis.

One sub-mission of JNNURM is Basic Services to the Urban Poor (BSUP), a poverty alleviation scheme targeting slums, which does not require a specific

⁸ If I do not refer to a specific literature source, I use "government" in a broad sense as a system consisting of administrative, legislative, and jurisdictional activities within a jurisdictional territory (not as synonym for "governance"). Although I use Scott's (1998) work on state improvement schemes and legibility making, I mostly refer to these schemes as "government improvement schemes" instead of state improvement schemes for two main reasons: a) because the former more closely reflects empirical material (i.e. vocabulary used by research participants and respondents during fieldwork); b) some of these (and important in the context of this thesis) include changes in government as a system itself, especially on its administrative side (e.g. in case of e-government).

ICT for data collection and management⁹, but which relies on the use of diverse technologies already in place to list target areas and beneficiaries. BSUP seeks to improve the lives of slum dwellers through housing and infrastructure provision, and as such it is also deeply implicated in land and property use and ownership as well as urban planning interests and contestations more broadly. This is important to note, because although SDI may be developed within the framework of a given scheme (e.g. Nirmala Nagara), it may over time implicate other schemes and vice versa, because formal organizations as well as problems involved in different improvement schemes partially overlap. For example, there is a close connection between relocating slum residents on new plots of land and issues of land ownership and claim making. At the same time, previous slum improvement schemes were still underway and RAY was already on the horizon. A process, which cuts across these schemes, is slum declaration in Karnataka, essentially entailing the practice of classifying the city into slum and non-slum, into slum resident and non-slum resident – ideally in a comprehensive and unambiguous way based on a set of criteria according to procedure. Slum declaration provides the analytical framework to address the second research aim to study practices of information construction and exchange outside the SDI network. The research question, more concretely, is as follows: *What characterizes classifying practices in the case of slum declaration and in how far do these match the core tenets of SDI or not?* I address this question in section 4.2 of the thesis.

However, neither property database development, nor the classification of the city into slums and slum residents take place in and for themselves. Since the 16th century in Europe, surveying and mapping are seen as indispensable instruments of the state to plan, administer and improve society (Foucault, 2006; Scott, 1998). Accuracy, comprehensiveness, and permanence are key features of information required by the state to plan and govern (Scott, 1998). Through time the perception of spatial technology's use has become married to this line of thought. The history of cartographic practice is often written as one of technological progress leading to ever increasing accuracy and comprehensiveness of the maps' (and in extension databases' or websites') contents (Monmonier, 2011; Kitchin, Dodge, & Perkins, 2011). Today the state's need for accurate and comprehensive information and the opportunities afforded to provide such information through spatial technologies are taken for granted. Hence, the notion of legibility making by the state lines up relatively smoothly with property database development. The requirement to produce official knowledge – that is unambiguous and comprehensive – also underlies effort of classifying the city into slum and

⁹ The 2012-initiated Rajiv Awas Yojana (RAY) national slum improvement scheme requires GIS-based management of information about slums and residents, but this started after my fieldwork.

non-slum, albeit without the use of digital spatial technologies. Legibility making is an underlying requirement behind both SDI-based and non-SDI based practices. What is of interest then is how the two differ in making the city legible, the degree to which comprehensive and unambiguous knowledge is achieved, and how these potential differences support or not the implementation of improvement schemes. From this follows the third research question: *How do SDI-based versus non-SDI based practices of legibility making work out in reaching the aims of their respective government improvement schemes?* I address this question in section 4.3 of the thesis.

The first three research questions and related interpretations open a window into the broader scenery of state-citizen interactions in urban governance. Discussing implications of SDI in urban governance comes at a critical and opportune moment in time when SDI is still emerging and choices are still open. Future choices have socio-political ramifications that are difficult to predict in an increasingly complex landscape of actors involved in the process of (urban) governance (Stoker, 1998). Governance is so capacious a [magic] concept in the literature "that it could accommodate almost everything a government does, and could extend to other social actors too" [but] "there may be a rough common core residing in the notion [of governance] that steering society or making policy increasingly requires the active participation of a range of actors in addition to government itself" (Pollitt & Hupe, 2011; p. 646). Madon's (2009, p. 36) broad definition of governance "as a process of interaction between state and society" involves three critical themes manifest in literature on governance:

- a) the "complex set of institutions and actors from public, private and voluntary sector with no single actor having the knowledge or resources to tackle problems on their own" (Madon, 2009, p.36)
- b) the role of the state with discussions circling around the roll-back of the state, on one hand, and its continued centrality in the context of developing countries, on the other
- c) the notion of accountability and its meaning often discussed in conjunction with the notion of transparency (of government towards citizens).

Traditionally aligned with the premises of e-government, SDI is the continuation of "public authorities' natural inclination to gather information in order to govern society on the basis of that information" (Prins et al., 2012, p. 3). This accumulation of data and related processing activities can also mean a centralization of influence, control and decision making power in the hands of government as history has shown before. Here, we face the old question of centralization versus decentralization not only in terms of data,

inscription devices and modes of calculation and classification, but along with it also in terms of its control over society. From this point of view, SDI may serve to consolidate the state into a coherent entity vis-à-vis society. However, far from being a monolithic entity with one coherent interest, the state consists of a multiplicity of agencies with partially overlapping jurisdictions, with complex and emerging relations to private and research entities, and is increasingly tied into international bodies and regulations; the citizenry is just as incoherent (Fenster, 2006; 2012) and many agencies are involved in designing and implementing government improvement schemes and policy (Li, 2005).

We are faced with a (future) paradox. If the state is already complex, intertwined with non-state agents, and perhaps even dissipating under the forces of globalization and neoliberal tendencies, centers of calculation may as well emerge around data accumulation and calculative norms intertwining private, state, and societal actors. In that case, the data flows and nodes and related processing stations would determine who the agents are that drive government improvement schemes, planning, and policy. This flip-sided point of view in the discussion is not too far-fetched given the influence of private consultants already influencing public land use and urban planning (at least in India), partially because they have the spatial data and technology necessary to produce reports and maps to legitimize the planning process (regardless of its actual course and influential interests in the background). To put it simply, in how far will Google and Facebook end up planning our cities merely because they “have the data?”

Closely related to these issues is the ubiquity of a new generation of magic concepts – transparency and participation – in the sense of citizen access to government information and the ability to participate in government planning and decision-making (Bovens, 2007; Fenster, 2006; Meijer, et al., 2012). For SDI research in the Indian context this is especially relevant, where e-governance and e-government, including projects that involve spatial technologies in urban planning and land administration, explicitly promise to enhance transparency in government dealings and foster accountability to citizens (Madon, 2009; Raman, 2012). But it is questionable, whether and to what degree this is indeed the case and – what is equally important – how new transparency and participation mechanisms work in comparison to existing mechanisms in urban governance before digital veins spread into the corners and hallways of administrative buildings.

Raman (2012), for instance, argues that the rhetoric of transparency and participation surrounding the implementation of spatial technologies in master planning practices and land administration, have little to do with a reality, where processes seem to become rather more opaque and less participatory, especially from the point of view of the vulnerable and less

privileged end of the societal spectrum. The promise of making data accessible online after development of databases and integration across government departments and agencies is of little value to those, who require several documents and historical evidence to claim what is traditionally their land. It is even more obvious a problem for an estimated 93% of the Indian population without internet access (Wright et al., 2010).

Reliance on technological artifacts, such as websites and ICT kiosks (Madon, 2009) positioned as “neutral information channels” between state and citizen, in combination with a perception of information as data particles, de-contextualized and freely moving without human mediation, bears the risk of developing systems that become data- rather than process-driven (Schuurman, 2005).

Against the background of these multiple, partially contradictory, older and more recently emerging sociotechnical confluences in the arena of Indian urban governance, *the final research aim addresses possible implications of SDI development in urban governance, especially with respect to the role of the state and citizen participation.* This aim is addressed in section 5.2 of the thesis. Given the complexity of the situation, the many unknowns involved and inductive nature of my research, addressing the final question is more speculative providing hypothetical entry points for future research. These speculations derive from a comparison between SDI-based and non-SDI based practices.

Table 1.4.1 summarizes research questions, their relations to research aims previously identified in section 1.3, and the remaining thesis sections addressing each question.

Table 1.4.1: Research perspective, aims, and research questions

Research aims in relation to adopted research perspective (section 1.3)	Research questions formulated in correspondence with the empirical context	Sections in thesis
Explore the development of SDI as sociotechnical network at local and state-level across projects and time and identify problems encountered	1. How does SDI development take place in the case of digital urban property database development and what are the problems encountered?	4.1 & 5.1
Explore the outside of the SDI network, that is the actors and rationales involved in non-SDI based practices of information construction and exchange	2. What characterizes classifying practices in the case of slum declaration and in how far do these match the core tenets of SDI or not?	4.2 & 5.1
Compare SDI and non-SDI based practices to explore in how far they each support implementation and aims of government improvement schemes	3. How do SDI-based versus non-SDI based practices of legibility making work out in reaching the aims of their respective government improvement schemes?	4.3 & 5.1
Discuss possible implications of SDI development in urban governance (based on the comparison between SDI-based and non-SDI based practices)	4. What are possible implications of SDI development in urban governance, especially with respect to the role of the state and citizen participation?	5.2

In section 1 I have tied my questions into global SDI discourse and knowledge domain by distilling the research perspective and aims. In order to formulate questions more specifically as anchor points for writing the remaining sections of the thesis, I briefly sketched out the Indian urban context.

In the following sections I will further elaborate on the other two aspects that informed the research aims and questions. In section 2, I describe the process of fieldwork through a multi-site ethnographic approach as well as the main elements of the empirical context. In describing the empirical context, I start with a summary of the Indian NSDI as a backdrop to the urban scene in Karnataka, which is characterized by a multiplicity of e-government projects, on one hand, and administrative paper work, on the other. I will also elaborate further on several government improvement schemes that were being implemented during the time of fieldwork.

2. Moves across the empirical setting: Fieldwork and the SDI scene in and around urban Karnataka

My methodology may be best labelled a multi-site ethnography (Crang, 2005; Hannerz, 2003; Hine, 2000; 2007) or “mobile ethnology” as it refers not only to the written account or description of another place and “folk” (ethno-graphy), but also to the conduct of fieldwork, interpretation, and writing (Czarniawska, 2007). I mainly opted for a multi-site ethnography, because the development of infrastructure takes place across diverse settings and administrative scales. This will be further elaborated on in section 3, where I discuss the interpretive aspects of the methodology.

In the publications in Part II, I refer to the methodology as a multi-site qualitative study rather than multi-site ethnography. This is because ethnography is sometimes equalled with participant observation. “[M]ultisite ethnographies seem to retain more of a pluralism as regards sources to include a range of ‘polymorphous engagements’ ” than participant observation only (Crang, 2005, p. 229). According to Hannerz (2003, p. 212), a multi-site ethnography does not only involve “interacting with informants across a number of dispersed sites, but also doing fieldwork by telephone and email, [and] collecting data eclectically in many different ways from a disparate array of sources.” As such it allows the researcher to compare empirical material and theory, but also to identify patterns of discrepancies within people’s own descriptions, which would otherwise not have emerged, and which are an important aspect to bear in mind during interpretive research (Myer & Klein, 1999).

I conducted fieldwork in five periods ranging in length between two weeks (pilot study) and five months during the time between 2008 and 2012 in a variety of sites. The term “site” has four meanings in the context of this study. It refers to cities, to places in cities (administrative offices or neighborhoods), to regularly repeated events (for instance public review meetings of government program implementation in the municipality) as well as to administrative levels (municipal, district, state, etc.). These meanings, of course, overlap. The slum office in Mugdali was an important site within the municipality, but at the same time administering three districts, including the district of Mugdali.

In my choices on when and where to move, I followed Hine’s (2000, p.60) advice for a multi-site ethnography: “Ethnographers might still start from a particular place, but would be encouraged to follow connections which were made meaningful from that setting. The ethnographic sensitivity would focus on the ways in which particular places were made meaningful and visible. Ethnography in this strategy becomes as much a process of following

connections as it is a period of inhabitation.” Accordingly, sites emerged as nodes relevant to the study of slum listing and digital property database development, the two processes, which became the focus in this study.

For example, regarding property database development I gained insights into the perspective of staff in municipal offices in the city of Dhabunagar, who send a lot of data to state-level offices. Hence, I followed the information trail to state-level in order to gain insights into the perspective of the recipients of reports and other information sent from the cities. In the slum district office in the city of Mugdali, relations between neighborhoods, various resident leaders and non-governmental organizations were clearly influencing the process of slum listing. Sometimes, it was less me who chose, but rather the people I engaged with, who suggested or simply took me to a place, which they found could be of interest to me or simply in order to show me examples of progress in scheme implementation.

However, the integrated research program, of which my study is part, also influenced fieldwork and site selection. For instance, the cities of Mugdali and Dhabunagar in Karnataka, and the city of Kadovali in Maharashtra had been pre-selected as cities prior to my involvement in the program. Relations between senior researchers in the program and administrators in these cities provided initial points of contact and access. Cities were chosen, because they are mid-sized, and consequently relatively under-studied compared to large urban agglomerations like Delhi, Mumbai or Chennai. Furthermore, cities were selected for their involvement in e-government initiatives, including GIS-based property database development.

I expanded city sites to Bangalore, Delhi, and Mumbai in order to gain insights into state and national level perspectives on the processes being studied. In Delhi I mainly focused on the NSDI initiative. Fieldwork in Maharashtra served as possible “negative cases and the resulting opportunity to modify the explanation” (Katz, 1983, p. 130) from my previous interpretations of slum listing and BSUP implementation practices, based on Karnataka. The integrated research program also influenced my choice to focus on slum listing, a process which guided site selection or “tracing” in addition to digital property database development. The reason was the program’s emphasis on mapping multiple urban deprivations, a concept which quickly translated into “poverty and slums” in conversations in Mugdali, leading me to the slum district office and from there into the construction of lists, maps, and reports unfolding across slum improvement schemes.

I combined different data collection methods depending on the situation and the different purposes in mind. In addition, the site itself sometimes only

allowed for the use of certain methods. For instance, at state-level offices it was possible to engage in observation only to a limited degree. Interactions were often characterized by a mix of formal interview with a tour of the facilities and more informal engagement with other staff members, who explained their work to me in more detail. Interactions at the municipal and slum district offices were much more informal. By returning to the office and surrounding neighborhoods regularly I also became more engaged in the work at these offices. I made use of participatory mapping methods and actor shadowing (Czarniawska, 2007) to a rather limited degree.

Most interviews were not recorded, because respondents did not want this. As time went on I often did not even ask, because I had learned that for the most part recorded interviews produced ideas and information that can be looked up on websites or in official documents. When interviews were recorded, they were transcribed in entirety.

When interviews were not recorded and during observation I took notes in the form of key words and phrases during conversations and observation, which I elaborated on afterwards, and digitized in the evening in a "professional" field notes document (Goodall, 2000). This document also includes links to photographs and other materials collected as well as interpretive notes, which (habitually) I indicate using "Own note/thought." In addition I kept a personal diary, which contains elaborate and regular, but not daily, entries about the research process not only in India, but also in the broader program context, including workshops and discussions in Europe and in the office in Netherlands. This more "intimate" document provided a means to reflect on my own interpretations, because it contains "strangely meaningful conversations" or troubling events, as well as "random reflections on what it all means to me" (Goodall, 2000, p.87-88). The reader can find particles from the personal diary translated into the footnotes of the thesis.

By including informal conversations and observation, ethnography allowed me to draw on insights from a variety of situations. For example, it was often necessary to return for scheduled interviews several times due to commitments of the interviewee, and I often spent up to five hours waiting in administrative offices. These times allowed for opportunity to engage in informal conversation and observation beyond the "formal" interview with the anticipated respondent (Goodall, 2000). In addition, the boundaries between formal and informal, between official and private, between job and home are very blurred. This also influenced, how I could go and went about my business. People leaving "official work" in the middle of the day for several hours to attend a wedding ceremony does not match a Weberian notion that separates between "private domicile of an official" and the "bureau for official activities" (Weber, 1978 in Hull, 2012).

Carrying out fieldwork across the boundaries of office and home, and between private engagements and officially scheduled interviews was thus important for at least three reasons. First, it allowed me to build trust and often formed the basis for communication in the first place and to establish contacts with people, in turn easing “access problems.” Second, engaging in “unofficial business” and taking notes during bus rides or when waiting in front of offices provided a broader understanding of interactions around me, which also infiltrate and influence the processes studied and accounted for in the research. Third, conversations and interview topics carried forth from a more formal setting into the “private sphere,” and it would have been counter-productive to ignore the latter conversations because they were not part of the official interview.

The blurring between the “official” and “private” is also the reason, why I opted for fictitious city names (besides a few explicit requests for anonymity). Also, for many research participants, the terms anonymity and confidentiality as used in the context of social science research either carried a very different meaning or no meaning at all. I identified people in this thesis mostly by their position in a social setting, their rank within administration, or referred to them as representatives or staff members of a given agency or organization (see also introduction in Hull, 2012). It is worthwhile noting here, that this context as a whole also productively influenced, indeed may be regarded as further supporting, the interpretations of “empirical material” with respect to the blurred boundaries between state and citizen in urban governance.

What I refer to as “empirical material” is socially constructed through the interactions between the researcher and participants in the study (Klein & Myers, 1999). Because of language barriers and a steep learning curve in terms of behavioral norms on my part, the research involves a series of translations also at the linguistic and cultural level besides the scientific translations between empirical observation and the eventual text (Latour, 1999). One rather obvious example and illustrative of the sort-of inevitability in the construction of “empirical material” by both researcher and research participant is the case of business cards. Business cards play an important role in interactions with administration (for a detailed ethnographic account on this see Hull, 2012). My business card identified me as a PhD student at the ITC faculty of the University Twente. In some instances, my ITC faculty affiliation influenced who (and sometimes if) I was referred to from one interview(ee) to another. Several of my informants were ITC alumni. My role was partially constructed by respondents according to this affiliation, which also influenced the course of conversation. For example, at the beginning of interviews or in conversations, people would elaborate on the benefits of using GIS even if GIS turned out (later in the conversation) to be not used in

or even useless to their work. It is also important here to admit that sometimes I was not sure, what I was observing or shadowing. For example, the survey of slum residents and land in some cases seemed to be a rather "staged undertaking." There may have been instances when a survey was staged for me simply because I asked to witness it. Nevertheless, I do not regard these concerns as a limitation to this research as they actually helped to raise interpretive questions, such as my interpretation of the slum survey as a front stage activity within which informal conversations between administrators and residents can take place (section 4.3).

A difficulty pertains to time lines. Often official documents (digital or paper) lack publication dates (sometimes also author) making the establishment of time lines and descriptions of projects and programs a frustrating undertaking requiring a fair amount of triangulation between different materials. Czarniawska (2007, pp.16-17) notes that "time in contemporary, complex organizations is condensed, and it is counted at many places concurrently" making a traditional dealing with space (for instance through observation in one office) problematic as "organizing takes place in a net of fragmented, multiple contexts, through multitudes of kaleidoscopic movements. Organizing happens in many places at once and organizers move around quickly and frequently." Hence, while recognizing that this spatio-temporal complexity justifies a multi-site approach, the combination of such an approach with fieldwork conducted at different time periods did complicate documentation. For instance, I studied the process of slum listing more in Mugdali and Kadovali than in Dhabunagar, while I studied digital property database development in Mugdali, but more so in Dhabunagar.

In the following sections I provide a descriptive fly-over across the empirical context I encountered¹⁰ during the multi-site study. The description is anchored in SDI and GIS implementation, computerization and the use of maps in the main municipalities visited, and government improvement schemes underway during research. To review developments in the Indian NSDI initiative I draw on document review and interviews with national and state-level NSDI stakeholders in February and March 2011 in Delhi. I also followed news items online and participated in the 10th International workshop of the Indian NSDI in collaboration with the Association of Geospatial Industries (AGI) 23-24 December, 2010 New Delhi, India). These materials have only been partially analyzed (not published), and only serve as basis for the empirical context description in this thesis. Descriptions of the urban context derive from fieldwork and empirical material which forms the backbone of interpretations discussed in section 3.

¹⁰ Obviously, this does not include everything related to SDI, for instance readers familiar with the Indian NSDI context may note that mentioning of National Informatics Center (NIC) is relatively sparse as I did not have much interaction with NIC offices.

The explicit Indian NSDI initiative is empirically manifest mainly in discourse, especially documents and annual workshops¹¹, but also more recently in the form of state-level geoportals developed on the basis of natural resource databases and organizationally tied to rural administration. The urban arena in Karnataka is characterized by GIS initiatives not related to the NSDI. However, first I sketch out the Indian NSDI at national level and move into the Karnataka scene before focusing more explicitly on the urban arena. Consequently, the moves across the empirical scene are not in chronological order. For instance, the first rounds of fieldwork took place in Karnataka, mainly in Mugdali, whereas I visited Delhi only later on in research.

2.1 From Indian NSDI: between national documents and rural Karnataka

The NSDI in India was initiated in November 2000 when a task force was set up to prepare a viable strategy and action plan (DST, 2001). The initiative originated in discussions among the Department of Science and Technology (DST) and Indian Space Research Organization (ISRO) scientists with a rather explicit aim to emulate Western NSDI programs (Georgiadou et al., 2005a; Puri, 2006; Puri et al., 2007). A Strategy and Action Plan for an NSDI in India was adopted in a conference in New Delhi on February 6, 2001 (DST, 2001).

Subsequently five more milestone documents have been published through the NSDI initiative providing insights into its development during the past decade¹². NSDI stakeholders have also drafted spatial data sharing and access policy documents. In 2005 the National Map Policy was unveiled by the Ministry of Science and Technology. The policy aimed to provide, maintain and allow access to the National Topographic Database (NTDB) of the Survey of India (SoI) conforming to national standards and to promote use of geospatial knowledge across all sections of society (Coordinates, 2005, May). At national level NSDI holds annual workshops to discuss international developments in GSDI and advances in spatial technologies, as well as to review progress on Indian NSDI along with various other initiatives across India, including local level GIS initiatives and state-level projects. In 2012 the National Data Sharing and Accessibility Policy was published, also by the Ministry of Science and Technology, and in the same year a National GIS policy document was published in 2012 by the Planning Commission of the Government of India (GoI). The National GIS is envisaged as a fundamental

¹¹ <http://nsdiindia.gov.in/nsdi/nsdiportal/annualevents.html>

¹² 'The Indian Spatial Data Infrastructure – The Vision Ahead' (Kumar, Rao, & Dasgupta, 2004), 'NSDI in India – Through the Years' (Krishna Krishna, Kingdang, Malaviya, & Misra, 2010), 'Indian NSDI - A Passionate Saga' (Kumar et al, 2009), and the 2011 evaluation report "Aspiration document for NSDI" (DST, 2011).

component of India's critical democratic and governance infrastructure, providing GIS support to many aspects of the national economic and governance process that would benefit the nation. The elements of the National GIS platform are infrastructure, data assets, portal, decision support applications and capacity building.

Progress in NSDI development, in terms of the core tenets of SDI outlined in the introduction, has been often criticized as slow and misguided. Arup Dasgupta comments in an editorial to *Geospatial World* that "both the US and India have named their SDI efforts as 'NSDI.' While the FGDC [Federal Geographic Data Committee in the U.S.A.] has moved forward at a steady pace, the Indian effort has stuttered along, with an annual jamboree as the main attraction" (Dasgupta, 2011). A leading figure in the NSDI initiative, who was also member of the 2005 map policy drafting team, stated in an interview that the policy ended up "making things worse" because the DST proposed to commission a dual series of maps, one for restricted use by the armed forces and another for unrestricted civilian use. On the latter maps for civilian use large areas along the countries' national boundaries were greyed-out under the new policy. Similar concerns were expressed regarding progress with GIS adoption. Mukund Rao, a policy entrepreneur and intellectual leader of both the Indian NSDI and National GIS platform, observed in a 2010 interview that the benefit of GIS has not yet reached, where it is ultimately required – particularly in governance, decision making, and citizen engagement. "The GIS initiatives we have done for the past years have certainly been successful to prove the potential of using GIS to address various development objectives, but GIS is yet to get assimilated and become a part of the process of governance, planning and nation-building in entirety." ¹³

During the course of this research I found metadata standards, as well as national and state-level geoportals rarely, or not at all, used in actual administrative work in the cities I visited both in Karnataka and Maharashtra. According to representatives from ISRO and Delhi State Spatial Data Infrastructure (DSSDI) the NSDI metadata standard is not applicable across many data-producing agencies. Many agencies reported in the 2010 International workshop of the NSDI that they are still in the process of digitizing analogue maps.

In response, leading figures in NSDI have recently sought to bring the initiative closer to the "end user" and to better address the needs of local administration. The past seven years have witnessed a "move of national SDI initiative to state level" (NSDI chairman in interview, 1 March 2011). This

¹³ <http://www.esri.com/news/arcnews/winter0910articles/mukund-rao.html>

move is most manifest in the launch of state-level geoportals across India, also referred to as state-level SDIs. In 2012 the entire annual NSDI workshop was dedicated to presentations of state-level SDIs (Dasgupta, 2012).

In Karnataka the state-level geoportal was implemented by the DST office in Bangalore on the basis of the Natural Resources Data Management System (NRDMS). The geoportal includes Indian Census data and data collected by the staff in individual NRDMS spatial data centers (district level office in the Zilla Panchayat). The geoportal was initiated in 2008 and inaugurated at the 2009 NSDI workshop. It offers access to Census data maps and allows users to perform spatial queries based on administrative boundaries and respective attribute data. However, at the time of fieldwork interviewees from municipal and state-level departments in Karnataka were either not aware of the state-level geoportal or considered the scale and data content irrelevant to their work. According to a DST official involved in geoportal development *"the only people, who call about the geoportal and available data are foreigners."*

The main concern at state and district-level offices of the DST is to embed GIS in administrative work processes, identify and foster the need for GIS and related data use among local administrators (for instance through repeated GIS workshops), and to digitize and integrate dispersed spatial data in district and state-level databases.

The Karnataka Remote Sensing Application Center (KSRSAC), organizationally related to ISRO (Department of Space, DoS) is another major stakeholder in NSDI, and works in parallel to DST at state and district levels. The two main NSDI agencies, DST and DoS, each seek out own niches in a competitive market over spatial technology and data production and use. KSRSAC, for example, has recently secured funding to assist in the development of GIS databases for urban slums under the framework of Rajiv Awas Yojana (RAY), a 2012 initiated urban government program. On the other hand, SDI and GIS activities implemented through DST in Karnataka continue to focus more on rural areas. Built on the basis of NRDMS database and with a 20 year history of focusing on natural resources and rural area concerns, the DST spatial data centers are located in the Zilla Panchayat offices and tailor GIS work mainly to rural administrative tasks. The latter formally administers the whole district, but in practice its focus is on rural areas. Larger cities within the districts are administered by urban local bodies (municipal corporations in the case of Bangalore, Mugdali, and Dhabunagar) as well as regional development authorities and various para-statal boards in charge of specific service deliveries to citizens and government program implementation.

In sum, as one moves from national level NSDI endeavors towards district level work GIS database implementation and embedding GIS use in administrative practices become increasingly important. The explicit NSDI initiative in India has difficulties infiltrating the arena of urban administration and planning in Karnataka, partly because of the traditionally rural and natural resource focus in the practice of both DST and ISRO, and competition among agencies enrolled in the NSDI initiative, but also because of the multiplicity of spatial technology initiatives in the urban arena and the role of private consultants in urban and regional planning.

2.2 ... via SDI multiplications: GIS initiatives in urban Karnataka

In the meantime, several GIS development projects have explicitly targeted the urban arena. Some are related to NSDI, for instance the Delhi State Spatial Data Infrastructure (DSSDI) and the National Urban Information System (NUIS); the leading figures of each are also key figures in NSDI. The DSSDI is also considered a state-level SDI and represented as such in annual NSDI workshops as it involves state and municipal departments in Delhi. Others, like NUIS, target GIS database development in several cities. NUIS was launched in 2006 by the Ministry of Urban Development (MUD) with the aim of developing GIS databases for initially 137 towns and cities in Karnataka, including non-spatial data on "urban indicators." These databases were to serve as basis for the preparation of Master and Development plans (<http://urbanindia.nic.in/programme/lsg/nuis.htm>). Implementation guidelines were published by the Town and Country Planning Organisation of MUD. In Karnataka six smaller towns were included: Bellary, Bidar, Bijapur, Davanagere-Harihara, Kolar, and Raichur.

Although the SoI is officially an implementing agency of NUIS, at the time of fieldwork in February 2011 KRSAC staff worked on digitizing various features from satellite images for cities in Karnataka. At that time the NUIS database for Karnataka was supposed to cover 4378 cities with the 137 previously selected, now listed as priority cities according to KRSAC staff. Primary data sources were satellite images (merging Carto 1 and LISS IV to get a final resolution of 2.5 meters). For this purpose, ancillary data sources were being collected from other departments in cities, District Commissioner offices, and the SoI, for instance administrative boundaries, forest boundaries, village location names, city, and town boundaries. Database design and development guidelines follow a common standard for cities across the country, because finally data was to be integrated into a national level database and from there to be delivered to departments in all cities between 2010 and 2012 (http://urbanindia.nic.in/programme/lsg/nuis/nuis_timeline.pdf).

However, in a 2011 conversation in Delhi, a leading figure in NUIS stated that progress on NUIS is much too slow in light of rapid urban growth. Staff at KRSAC reported in 2011 that digital data was ready for only five of the 137 priority towns in Karnataka. The NUIS project does not include Bangalore nor did it involve urban administration in Mugdali and Dhabunagar at time of fieldwork.

Empirically manifest in the cities are GIS initiatives independent from NSDI and NSDI-related initiatives (such as NUIS and DSSDI). Especially important in Karnataka's urban arena are GIS projects related to urban property taxation and land administration. At the 2011 "Municipalika" conference on urban governance in Bangalore a full session was dedicated to the implementation of "e-governance" programs, and the development of digital spatial databases for property registration featured prominently among the presentations and discussions. At the booths of all major municipalities in Karnataka the same reform priority was repeated: "We are now developing GIS for urban property recording." These efforts reach back to at least the early 2000s in Karnataka.

In 2004, the Chief Minister of Karnataka gave his approval for the municipal reforms project *Nirmala Nagara* ("Clean City"). The program was launched in 2005 by the Government of Karnataka in 57 cities, including Mugdali, Dhabunagar and Bangalore, to take advantage of JNNURM's reform agenda. This scheme's main focus is the implementation of municipal e-governance systems (Ranganathan, 2012). It was initially funded by the Asian Development Bank as part of an urban infrastructure project in northern Karnataka. In 2006 the World Bank took over most of the funding and expanded the scheme to include the computerisation of the functions of all municipal corporations in Karnataka. One of the scheme's components is the "Geographic Information System (GIS) based property tax system" (in this thesis: "GIS property mapping"). In Dhabunagar and Mugdali survey work for GIS property mapping started in 2006. Prior to this municipalities had developed a tax management information system (MIS) without a GIS component. *Nirmala Nagara* is at the moment the largest project for municipal e-governance in the world and its initiatives are being scaled up to other cities across the country (Desai & Sanyal, 2012).

In 2008 the Department of Land Resources initiated the National Land Records Modernization Programme (NLRMP). At time of fieldwork, Mugdali and Dhabunagar were both part of the program. Ideally, properties and transactions are recorded in the NLRMP database first and used also by the ULB for purposes of tax calculation and collection. Implementation of NLRMP began in Dhabunagar through the District level office of the Survey Settlement and Land Records Department (under state Revenue Department)

in 2010 and is locally referred to as the "City Survey." The City Survey covers both ULB area and an additional "urban growth area" around the ULB. The objective is to move from presumptive to conclusive titling, to protect buyers of land and prevent litigation through a standard reference system for land parcel boundaries, to categorize land according to ownership types (government versus private), and to identify "wasteland."

These projects are amidst many programs attempting to modernize land tenure systems through ICT based data management. The changes in program names reflect the "project-like" character and relatively short time frame of each endeavour. In 2002 a project called "Urban Bhoomi" initiated two pilot projects, which never came to fruition. In 2006 a similar pilot project took place in Belgaum District called "e-city survey." Interview respondents often used these various project names interchangeably. Nevertheless, there are aspirations to integrate and centralise databases at state-level. Individual projects and programs may or may not evolve into larger scale information infrastructures; and some implementers of Nirmala Nagara in Karnataka refer to the development effort as municipal SDIs.

The current focus on property registration is in itself nothing new. Land tax has been the major source of revenue for all governments of India, including the British Raj, especially after establishing direct rule in 1857 (Bannerjee & Iyer, 2005). The British set up various land tenure systems in different areas depending on the influence of individual administrators, political events, date of conquest, and presence or absence of a landlord class (Bannerjee & Iyer, 2005). Independence brought the formation of new state boundaries subsuming different areas and corresponding tenure regimes. Karnataka was constituted after Independence from several regions, which had been governed under five customary regimes and within these counted up to 1500 forms of tenure (Benjamin, et al., 2007). Litigations over land and evictions have been numerous in urban as well as rural areas (Morse, 1950).

2.3 ... towards municipal administration: digital islands in a sea of paperwork

Computerisation started in the state of Karnataka in 1987 with the launch of computers in districts for routine processing applications (Madon & Sahay, 1996). The state has since gained a reputation for its leadership in e-government.

In Mugdali and Dhabunagar in Karnataka digital data management and computerization of administrative tasks within the ULB is driven by the IT departments. In Dhabunagar this is referred to as the MIS (Management of Information) department. The municipalities are divided into administrative

zones with zonal officers and administrators in charge of overseeing the ground work in various sectors, including property tax collection, water supply and billing, drainage and sanitation, and public works, including road construction and maintenance. Both IT departments in Mugdali and Dhabunagar maintain central servers connected via network to the offices at zonal level. The system supports mainly processes of birth and death registration, public grievance registration and response, property tax collection (at time of fieldwork without GIS component), budgeting and accounting.

Under the framework of Nirmala Nagara, computerization efforts were vigorously promoted by an ambitious municipal Commissioner, who was later transferred to Mugdali, where he continued to drive computerization efforts based on the Dhabunagar example. Specialists and programmers in the IT department in Dhabunagar are hired through Universities, and develop software applications "in-house" according to locally specific administrative procedure and regulations. The latest effort is the development of a system to streamline and computerize the issuance of building permits, which is to be linked to the existing property tax collection system, an endeavour apparently independent of GIS implementation under Nirmala Nagara.

Most e-government applications and databases are developed to support existing administrative workflows and procedures, such as issuance of building permits. Explicit aims to improve these processes through computerization include increases in efficiency in terms of time, better monitoring of a process in question, and/or to improve accuracy and updates of information. With respect to these aims there is often a lack of a perceived need among municipal IT staff to deploy specifically GIS. Of course, many information streams include spatial information in the broad sense, for example addresses, local landmark designations, street layouts, and assignment of jurisdictional delineations. However, they are not in congruence with spatial referencing systems required for conventional GIS use. The information lacks standard geographic coordinate system information; and datasets or files are not specifically designed for spatial visualization and analysis. Linking GIS into these broader processes of computerization remains difficult for organizational reasons and due to more tacit forms of resistance.

First, the relation between computerization efforts coordinated in IT departments, on one hand, and specific GIS implementation projects, on the other, may be weak. In Dhabunagar, for instance, the GIS specialist deputed from state-level agencies to coordinate GIS property mapping under Nirmala Nagara, worked mostly in isolation from the IT staff in charge of computerization in the municipality and familiar with the work across

departments. In Mugdali the Nirmala Nagara GIS specialist was transferred and replaced by a new person during the time of fieldwork due to "lack of progress" according to municipal officials. The new deputed specialist was not only ill-informed of the status of work, but also unfamiliar with the inner workings of the revenue department, and had difficulties establishing day-to-day relationships with bill collectors and officials in the municipality. This lack of support incapacitated the new GIS specialist for some time. In Kadovali GIS implementation takes place in a different organizational framework, which I do not elaborate on further in this study as the focus was on Karnataka. In Kadovali another barrier to GIS implementation in administrative work processes are dependencies on the expertise of private GIS consultants rather than in-house software development.

Second, the attitude of individual administrators, especially municipal and district commissioners, toward the use of GIS differs and thus influences, in how far GIS becomes linked into broader computerization efforts and administrative work. A state DST official summarized his experience in past 20 years and identified three groups of administrators with respect to their attitude towards the use of GIS: a) those interested to find out how it can support their work and implicitly or explicitly further the introduction of GIS in support of administrative tasks, b) those who want to keep things the way they are and reject or sabotage the introduction of GIS into practice, and c) those who want to "use" the technology more as symbols of prestige and status (see also Noir & Walsham, 2007). Related to this, and applicable to computerization more broadly, is the perception among some administrators that their authority dissipates, if work processes become increasingly dependent on the technical work of people who are of lower rank in the administrative hierarchy or deputed from private industry and universities. This is not an unreasonable perception of risks involved given the de facto powers of IT departments across municipal administration.

Heads and staff of municipal IT departments may become vested with significant influence in the affairs of municipal administration. In Kadovali, the head of the IT department has influence over information flows across municipal departments and government schemes being implemented, also vis-à-vis Commissioner and Mayor. He is at the same time Head of the Revenue Department and a Department called "Illegal construction." Besides the strategic positioning of individuals as heads of various departments, the influence of IT departments also arises, because increasingly information produced and managed on paper and in desktop applications passes through the IT departments for digitalization, especially to generate reports for review meetings and for submission to funding agencies.

Third, there is a form of tacit resistance to spatial visualization and the use of maps in administrative work. The ability of maps to reveal spatial patterns that may otherwise (for instance a table or list) go unnoticed, and the possibility of overlaying various features and their relations may be regarded as a plus point for maps from the perspective of a scientist or planning consultant who is interested in discovering and analyzing socio-spatial patterns of cities. However, to administrators engaged in urban day-to-day tasks, especially in interactions with politicians and entangled in multiple interest associations and alliances, such visual exposure, and even more so the social constructivist nature of map representations and their performative power (Kitchin, 2008) make mapping a risky endeavor with difficult to predict consequences not only for the administrator, but also for many other people in the city.

A map of illegal construction areas, for instance, can have different consequences for a multitude of actors ranging from migrants who attempt to stake out a piece of land in the city by fostering alliances with local and state-level politicians to administration-sanctioned construction by large-scale real developers. Under a "planning regime [that] is itself an informalized entity, one that is in a state of deregulation, ambiguity, and exception" (Roy, 2009, p. 76) what gets shown as "illegal" on such map depends in turn on the interests of the map authors. Map making itself is viewed as part and parcel of the decision-making and implementation process requiring a fair amount of diplomatic finesse among GIS specialists as indicated by the following quote:

I have to make sure to inform officials that I do not make their decisions. I only do what they ask me and tell me to do and show that on maps and through analysis, because sometimes before when I took more initiative to prepare the maps, officials would say 'Sir, you don't dictate us, you only give us data and maps. Whether to implement, whether to take what decision, is not your problem. (GIS specialist DST spatial data center, here referring to rural administration, interview, 19 January 2011).

In sum, part of the difficulties of linking GIS, and mapping more broadly, into other computerization efforts and administrative work, actually stems from in-practice awareness among administrators that maps are social constructions and that "much planning, conceived as the realization of rational intention, is shaped by wider socio-cultural trends" (Hull, 2012, p. 56).

Computerization (and GIS) related activities are in turn surrounded by a sea of administrative work based on paper records and the use of stand-alone desktop applications, especially Microsoft office applications. This wider

panorama around the IT departments, GIS initiatives and their deputed GIS specialists becomes more apparent when one considers the work involved in the implementation and monitoring of government improvement schemes in cities. Implementation involves the necessity to coordinate and exchange information between departments and agencies across administrative levels and cities depending on program design and aims as compared to the aim of computerizing a specific procedure or work flow within the municipality.

During fieldwork JNNURM was being implemented in Mugdali and Bangalore in Karnataka (and Kadovali in Maharashtra). Basic Services to Urban Poor (BSUP), a sub-mission under JNNURM, sought to improve the lives of slum dwellers through housing and infrastructure provision. It was administered at national level by the Ministry of Housing and Urban Poverty Alleviation. The main thrust of BSUP was the "integrated development of slums through projects for providing shelter, basic services and other related civic amenities with a view to providing utilities to the urban poor" (MoUD, no year, p. 6). BSUP did not require a specific ICT for data collection and management, but through the practice of "slum listing" used diverse technologies already in place to list target areas and beneficiaries. The 2012-initiated Rajiv Awas Yojana (RAY) national slum improvement scheme requires GIS-based management of information about slums and residents, but this started only after my fieldwork.

In the work related to implement BSUP the role of non-administrative actors becomes more pronounced and the complex associations between government and non-government constituted and carried out through paper materials and documents within the government program. As Hull (2012) writes in the introduction to "Government of Paper" "the modernist program for shaping social order through built forms had expanded a material regime of another, equally significant sort: a regime of paper documents" (p. I).

This regime of paper documents carries well beyond the program framework of BSUP. It is visible also in the ubiquitous practices of letter writing, for example. This is important within administration, also with relevance to spatial data sharing. The procurement and collection of digital or analogue data as well as receiving permission to re-use data usually involves a series of letters, respective stamps, and signatures by officials depending on purpose and context of the data, paper documents and analogue maps. Letter writing also plays an important role in the communication between government and non-government. In the framework of BSUP most concerns and complaints directed to urban administration are voiced by slum residents via various mediators, including locally elected representatives and other kinds of neighborhood leaders. However, especially when there is great urgency or when accusations of fraud and abuse of power lead to a loss of

trust in neighborhood leaders people address municipal government, especially the Municipal and District Commissioners and Mayor, directly either through letters in combination with personal visits and more open forms of protest such as sit-ins at municipal and district office gates and buildings.

Overall, at the time of fieldwork, poverty alleviation programs were implemented by government departments and "implementation cells," which were less computerized in terms of both digital networks between offices, but also in terms of using digital versus paper records. Another urban poverty alleviation program is Swarna Jayanti Shahari Rozgar Yojana (SJSRY) that was underway in both Mugdali and Dhabunagar during fieldwork. The program focuses on education, training, and employment among urban residents below the official poverty line (BPL).

On one hand, the staff at the "SJSRY cell" in Dhabunagar expressed frustrations about the fact that they still had not received an internet connection, while the taxation procedure in the municipality had already been computerized. On the other hand, computerization of administrative processes may pose a barrier from the perspective of poorer sections of the urban population, who need to rely on human and paper mediations in their interactions with administration. Table 2.3.1 provides an overview of the various government programs and initiatives described in this section. The last column indicates the role of these programs in the context of my study as reflected in respective sections of the thesis.

Table 2.3.1: Overview of government programs, cities involved, their relation to spatial technology being promoted and their role in this research.

Government program	Administrative level driving the initiative	Implementation in Karnataka	Fieldwork cities involved	Spatial technology explicitly promoted	Role in this research
NSDI (since 2001)	Two main agencies: Department of Science and Technology (DST), including the Survey of India (SoI) Department of Space (DoS), including ISRO (with KRSRAC in Karnataka)	At state and district levels mainly in rural areas, recent projects in urban arena (KRSRAC)	Not explicitly manifest	SDI, especially GIS and RS	Sketch out of empirical context and SDI development in India (thesis sections 2.1 and 4.2)
National Urban Information System (NUIS)	Ministry of Urban Development, Survey of India	KRSRAC		GIS, RS	(tangentially related to NSDI, but not a focus of research)
Land administration projects (NLRMP, "City Survey," including Nirmala Nagara)	Various national or state-level government departments	In towns and municipalities across Karnataka	Mugdali and Dhabunagar (in Karnataka)	GIS, GPS	SDI development at local and state-level (section 4.1)
GIS property mapping component in Nirmala Nagara e-governance program since 2004	State-level Municipal Reforms Cell (MRC), Directorate of Municipal Administration, (DMA)	In urban administration across Karnataka	Mugdali and Dhabunagar (in Karnataka)	GIS	SDI-based practices of legibility making in government improvement schemes (section 4.3)
JNNURM (including BSUP), 2005-2012	National level (Ministry of Urban Development, Ministry of Housing and Urban Poverty Alleviation)	In two cities in Karnataka	Mugdali (in Karnataka), Kadovali (in Maharashtra)		BSUP as frame for analysis of classifying practice in slum declaration and non-SDI based practices of legibility making (sections 4.2 & 4.3)
Rajiv Awas Yojana (RAY), since 2012	National level (Ministry of Housing and Urban Poverty Alleviation)	In ten ULBs in Karnataka ¹⁴	Mugdali, Dhabunagar (in Karnataka), Kadovali (in Maharashtra)	GIS	(not yet being implemented during fieldwork time)
Swarna Jayanti Shahari Rozgar Yojana (SJSRY), since 1997 ¹⁵	National level (Ministry of Housing and Urban Poverty Alleviation)	In 227 ULBs in Karnataka ¹⁶	Mugdali, Dhabunagar (in Karnataka), Kadovali (in Maharashtra)		(in practice related to BSUP, but not a focus of research)

¹⁴http://www.rajeev.in/pages/..%5CNews%5CQuestions_Parliament%5CStatus_Implementation_Rajeev_Awas_Yojana_Karnataka.html

¹⁵ http://en.wikipedia.org/wiki/Swarna_Jayanti_Shahari_Rozgar_Yojana (Note: the program replaces three previous poverty alleviation schemes, one called Urban Basic Services to the Poor (UBSP), which is different from the more recent BSUP.)

¹⁶ <http://www.mrc.gov.in/SJSRY>. Officially, SJSRY was to replace earlier poverty alleviation schemes, including BSUP. However, both programs were being implemented in parallel in Mugdali alongside even older poverty alleviation schemes. In practice, there is a lot of overlap in implementation work in terms of actors involved at municipal and district level reflected also in the information artifacts (lists of beneficiaries and housing units, for instance) produced and used during implementation.

2.4 The empirical scene in a nutshell

In this description three main points are important to emphasize as they influence the theoretical conceptualizations and methodology of the research and in light of research aims and questions.

First, core tenets behind the concept of SDI globally are reflected also in the Indian NSDI discourse, for instance the emphasis on standards and integration to foster data sharing in government. Discourse in Indian NSDI puts a strong emphasis on GIS as a technology that allows users to “crunch together” data and process maps to provide spatial visualizations of information (DST, 2001, p. 1.2). Indian NSDI documents and more recently the initiation of the National GIS policy reflect the importance attributed to fostering GIS use in government. At state and district level offices, the institutionalization of GIS in administrative work and integration in GIS databases plays a paramount role in activities related to NSDI, but mostly for the administration of rural areas.

Second, the Indian NSDI initiative dissipates in the urban arena of Karnataka, which in turn is characterized by a multiplicity of GIS development efforts especially for land administration and driven from national (e.g. the NLRMP), or state-level bodies and non-governmental players (e.g. Nirmala Nagara GIS property database development). Although, there is a confusing multiplicity in projects and timelines, there are long-term aspirations to integrate and centralize property records and some participants speak of municipal SDI in this respect.

Third, although computerization in general has been taken up in Karnataka since the 1980s, more recent GIS initiatives are islands in an urban sea of paper work, where lists and tables, on paper as well as in stand-alone desktop applications, play a more important role in administrative work than maps; and the implementation of major government improvement schemes, such as BSUP, was carried out for a large part via paper and via mobile phone communication, at least during time of the research.

In sum, to understand SDI development in urban governance, the empirical context necessitates a departure from the explicit Indian NSDI initiative and a shift in focus onto GIS implementation in cities as well as a dive into the sea of paperwork. Furthermore, theoretical conceptualizations and interpretations need to take into consideration the influence of practices surrounding various digitalization and GIS initiatives as well as the long-term aspirations to integrate these into larger-scale SDIs.

Both the sketch of the study's perspective and aims in the introduction as well as the fly-over the empirical context in section 2 emphasize a need to take a look at the *inside* and the *outside* of the SDI endeavor: the rationales and actors driving SDI development, on one hand, and the rationales and actors positioned outside of a given initiative, on the other hand.

Next, in the last section of part I of the thesis I elaborate on the third of the three aspects, which my research questions connect, namely theoretical sense-making. In section 3 I will therefore elaborate in more detail on how I move conceptually from an *inside* to an *outside the network* perspective across research questions. By discussing the main theoretical concepts that informed my interpretations I will also clarify the conceptual origins of the terms "sociotechnical network," "classifying practices" and "legibility making," which appear in the research questions.

3. Interpretive moves: theoretical sense-making in dialogue with the empirical context

The metaphor “infrastructure” in Spatial Data *Infrastructure* (SDI) originally served to envision the development of a national SDI as a “superhighway,” implying centralized, top-down development approaches and emphasizing physical and technological elements of an information infrastructure (Aanestad, Monteiro, & Nielsen, 2007; Puri et al., 2007). Researchers working at the interface of Information Systems and Science and Technology Studies (STS), especially Hanseth, Monteiro, & Lyytinen (Hanseth & Monteiro, 1998; Hanseth & Lyytinen, 2010) and Star & Ruhleder (1996), have drawn on various ways to conceptualize information infrastructure (II)¹⁷. They aimed to understand the evolution of information infrastructures over time, their sociotechnical character in relation to organizing practices, their reach and scope as large-scale networks, the shared and open nature of II, as well as the politics involved in setting standards, a key ingredient of integration (Aanestad et al., 2007; Budhathoki & Nedovic-Budic, 2007; Georgiadou, Puri, & Sahay 2005b). This theoretical literature on different aspects of II informed my research approach from the start and was in my luggage already during my two-week pilot study in 2008 in Mugdali. Both led me to opt for an ethnographic methodology tending towards interpretivist epistemology (Klein & Myers, 1999; Walsham, 2006; Snape & Spencer, 2003).

The main rationale behind ethnography is to develop an understanding of the culture of a group, and people’s behavior and values within that culture (Bryman, 2012; Silverman, 2005). In the context of this study this is less about the “non-Indian” researcher trying to understand “Indian culture” (although this is part of the interpretive process), and more about eliciting differences between perspectives from *inside* as well as from *outside* a sociotechnical network. The *outside* is often perceived as an obstacle or a source of resistance to network evolution. This study seeks to flip perspectives and explore the rationales of the outside (the other culture so to speak) alongside the rationales among implementers and initiators of SDI (within the network). In other words, we need to look at the network also from the point of view of those outside asking, what SDI makers in potentia are doing and what are their rationales. This direction for the research is sketched out in the first publication in section 4.0, part II of the thesis, and further elaborated in sections 1.2 to 1.4. My own positionality aligns in the first instance with the rationales and ideas driving SDI development (inside

¹⁷ In section 3.1 the terms “cyber infrastructure” or “e-infrastructure” will appear on a few occasions. This is only in reference to the authors’ using them. Ribes & Finholt (2009) “e-infrastructure” as a more generic term for II. Bowker et al. (2010) use the term “cyberinfrastructure,” but embed this term in a discussion about II. For the purpose at hand, I therefore treat these terms as synonyms for II.

the network) in light of my role within the research program, my affiliation with a Geo-information Science (GIScience) faculty, and my past professional involvement in the promotion and use of GIS.

Ethnography also allows gaining insights into what is said, into narratives and myths, as well as what is actually done, and the interactions between both (Goodall, 2000). This elementary “actual doing” and “narrative/myth” dichotomy shines through the publications in part II and my interpretations throughout the thesis. It is reflected in the contrast between core tenets of SDI (in introduction) or expectations for SDI’s role (in section 4.2) and the actual practices of slum declaration. It lies at the heart of the differentiation between the ideal classification system narrated in procedure and the mingling with situated categories in the actual practice of listing slums. It is reflected in the ideal of a fully integrated digital urban property database, mainly a matter of discourse, and in the extant flexible and multiple modes of owning and using land in the city as well as in actual contestations over database ownership and maintenance.

The thesis is structured as an envelope of four publications (sections 4.0 to 4.3) each marking a temporary point of closure in interpretations, each with specific audiences in mind. For instance, in section 4.3 I compare practices of listing in the slum declaration process explicitly with assumptions underlying SDI implementation at local administrative level (rather than, for instance, assumptions underlying poverty alleviation programs), because the main audience of the book are SDI researchers and practitioners. The publications follow a representational style of ethnographic writing, which van Maanen (1988) refers to as “realist tales,” where the researcher’s role moves into the background and the social world of the Other is presented through an objectified description. The research process can be characterized as inductive and to some degree iterative, when new research questions emerged and old ones were reformulated as interpretations proceeded. Interpretations and writing may best be referred to as a theorizing through “disciplined imagination” involving a “consistent application of selection criteria to trial-and-error thinking [with] deliberate diversity introduced into the problem statements, thought trials, and selection criteria that comprise the thinking” (Weick, 1993, 516). The interpretive process is therefore akin to grounded theory in that it was characterized by an ongoing dialogue between empirical material and theoretical conceptualizations (Corbin & Strauss, 1990; Strauss & Corbin, 1994). Nevertheless, the conceptual core derives from II theory and related conceptualizations. In judging final interpretive moves outlined in section 3.3 and then further discussed in sections 5.1 and 5.2, it is important to bear in mind that it was only later in the course of this study that I moved into the direction of political and administration science. This process may best be described by use of an

analogy. After having wound my way through the forest of digital and paper infrastructures, mistaking deer trails for walking paths, resting at meadows and making decisions at road crossings, one fine day I reached a beach and stared at the vast ocean of political science (or rather the vast digital and wooden shelves filled with books from past centuries). I decided to stay on the shore, for the time being and only dip my toes into the ocean. The literature from the political science domain referred to for interpretation, follows from previous interpretative moves. For example Scott's (1998) concept of legibility making is closely related to the notion of the classificatory system by Mol & Law (2002) referred to earlier in the study. Hull (2012), who I also drew on for interpretation later, could make it onto the shelves of public administration science, anthropologies of the state, as well as STS¹⁸.

One can argue that social scientists have always been multi-sited or rather that they have always moved about physically or virtually, e.g. through databases or documents (Rip, 2000). Multi-sitedness refers as much to the interpretation of empirical material as to the conduct of fieldwork. Rip (2000) refers to this as "circulation" that makes robust knowledge possible, rather than methodology in the usual sense. A social scientist circles and aggregates among a range of interviews and documents creating a grounded picture and offering analysis, by means of various methodologies. Circulation requires a synthesis of materials not only across sites and time, but also across types of empirical material ranging from digital sources to notes written down during face-to-face meetings (Hannerz, 2003).

In light of this approach the following sections should not be mistaken for an a priori conceptual, boxes-and-arrows framework, adopted in the beginning of the research, prior to data collection and then applied to the "raw data" for analysis. Rather, I highlight and trace here the conceptual vocabulary and theoretical understandings as they took shape during the course of my entire study. Consequently, this section is interspersed with methodical notes and empirical material, since method and empirical context influenced the theoretical aspects highlighted. As such, my aim here is to make transparent and explicit the process of interpretation as it took place while each published paper was constructed (sections 4.0 to 4.3 in thesis) within the larger framing of the research questions formulated in the introduction. These relations are summarized in table 3.3.1 at the end of section 3. Thus section 3 directly addresses a persistent concern: a paucity in descriptions of the

¹⁸ Furthermore, it may be noteworthy here to mention an observation. Scott's work (1998) can be read through an STS lens. In Actor Network Theory (ANT) actions make the actors, not the other way around. In Scott's work the state makes legible, but legibility making also makes the state (1998).

interpretative process in multi-site ethnographies. Crang (2005, p.229) reminds us of this gap with reference to Salzinger:

“Translocal [and multi-site] research also extends the field into the home and the site of interpretation. The challenges here remain underdiscussed where we 'enthusiastically recount the ups and downs, the embarrassing- although always heroically turned to account – mishaps of research. But the many twists and turns of analysis are another story' (Salzinger, 2004, p. 6).”

These twists and turns have been smoothed to some degree and translated into the most important “interpretive moves” I have undertaken in the course of this study. A limitation in describing this process in the following sections is its narrow focus on the conversation between the author of this thesis, the empirical material, and literature. In reality, my interpretations were always informed and influenced by discussions with supervisors, with other researchers in the research program and with participants of workshops conducted at regular intervals during the duration of the research program. These settings provided the opportunity to discuss research questions and interpretations with European and Indian academics, as well as with members of Indian city administration, and civil society groups.

3.1 *From infrastructuring (inside of) the sociotechnical network*

A key notion in II development is that of integration. Integration is an ambiguous concept. It can refer to the seamless connection between databases, between stand-alone information systems, between data-holding and data-using organizations through collaboration and coordination in organizational and legal terms, as well as to the alignment of work processes. In II development “things are made to work together over distance and heterogeneous metrics” (Bowker & Star, 2000, p. 14). As a vision the concept of integration mobilizes political and ideological support among stakeholders with the aim of increasing efficiency and effectiveness in and across organizations (Ellingsen & Monteiro, 2008). II requires and at the same time implements integration.

It follows that an essential characteristic of II is its reach beyond a single event or a single site of practice (Star & Ruhleder, 1996). Sociotechnical networks tie up the knots and nodes of resources that are scattered across many places and connects them across space (Latour, 1987). But how does the outcome of such integration look like? When do we know that our (theoretical) gaze rests on an existing infrastructure? I discuss two closely related theoretical answers to these questions. One is the conceptualization of II as an evolving installed base. The other is the conceptualization of II as

Actor Network. Both conceptualize II as sociotechnical network emphasizing the multi-generational and emergent aspects of technological artefacts that arise as people (designers, developers, users, regulators, etc.) engage with them over time, and across a variety of contexts.

The first conceptualization has been advanced by Ciborra & associates (2000, 2004) and Hanseth, Lyytinen, & Monteiro (1998; 2010). A central concept is that of the "installed base:" II "are never built in a green field, nor do they die – though they may ... rise to new forms" (Hanseth & Lyytinen, 2010, p. 4). The trajectory by which II emerges depends on already existing technical and non-technical components, including standards, organizational structures, practices and social preferences (Aanestad, et al., 2007).

Over time new parts become integrated by extending the installed base or replacing existing parts. II is transparent when "plugging into other infrastructure and tools in standardized fashion" and not reinvented every time it is used (Star & Ruhleder, 1999). In this way an II is connected to other infrastructures in an ecology of networks supporting heterogeneous environments and shared by a large, diverse community of users (Hanseth & Monteiro, 2004). Sociotechnical networks always grow out of an installed base and expand on the same. Therefore, II is never built from scratch, but emerges "in modular increments, not all at once or globally. Because infrastructure is big, layered, and complex, and because it means different things locally, it is never changed from above. Changes take time and negotiation, and adjustment with other aspects of the systems involved. Nobody is really in charge of infrastructure. ... [and there simply is] no magic wand to be waved over the development effort" (Star, 1999, p. 382).

The concept of installed base also recognizes that II and II development carries an element of irreversibility due to "self-enforced path-dependency, where early design choices can change history by generating irreversible effects" (Hanseth & Monteiro, 2010, pp. 6-7). At the same time II development also carries an element of unpredictability. Sociotechnical constellations arise and morph in a variety of ways and often with unanticipated (positive and negative) effects. It is, for instance, difficult to predict how future uses and users will exactly look like (Ciborra & associates, 2000). The introduction of new technologies and the implementation of organizational structures and procedures have unintended side effects, even more so as integration across sites, things, and people increases (Prins et al., 2012; Stalder, 2011). "Side effects of local events often have global consequences. And, the more integrated the world becomes, the longer and faster side effects travel" (Ciborra & associates, 2000, p. 49). Over time sociotechnical choices (which software to use, the rationales and values embedded in classification systems, differential access via security log-ins,

and so forth) become invisible, embedded in the routines of software and people alike.

II is therefore embedded in other social arrangements and technologies. It is learned through membership and taken for granted inside a community of practice, whereas outsiders encounter it as target object to be learned about. This means that II becomes most visible – noticeable – when it breaks down (Star & Ruhleder, 1996). The embeddedness of II shifts focus from things and people as nodes in a network onto relations. II is not a thing or constituted by a number of technical and non-technical components. Rather “infrastructure is a fundamentally relational concept, becoming real infrastructure in relation to organized practices” (Star, 1999, p. 380).

Bowker et al. (2010) have ordered these various characteristics of II along two axes: the local-global and social-technical as shown in Figure 3.1.1 The development of infrastructure then is the continuous work that involves decisions that are distributed between these four poles: “In building cyberinfrastructure, the key question is not whether a problem is a “social” problem or a “technical” one. That is putting it the wrong way around. The question is whether we choose, for any given problem, a social or a technical solution, or some combination. It is the *distribution* of solutions that is of concern as the object of study and as a series of elements that support infrastructure in different ways at different moments” (Bowker et al., 2010, p. 7).

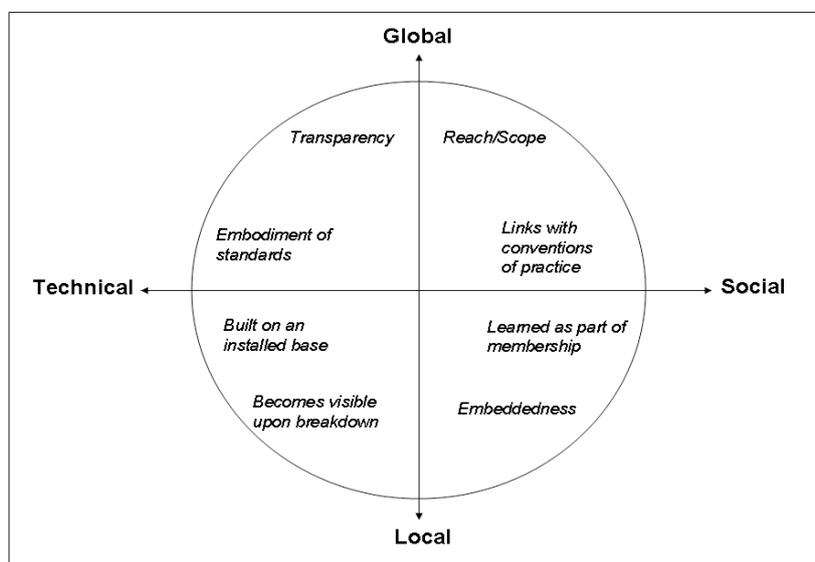


Figure 3.1.1: Properties of Information Infrastructure distributed across a continuum spanned by a local-global and a social-technical axis (after Bowker et al, 2010)

The properties of II were elicited on the basis of infrastructure projects that had been in the making for quite some time, such as the internet. They provide us with theoretical markers to describe, what and how II is and how it has emerged from the past. They may also offer clues to the participants in II development to guide them in the process of infrastructure development.

The second conceptualization also offers insights into past processes of sociotechnical network evolution. Actor Network Theory (ANT) offers analytical and conceptual tools¹⁹ to understand the process of network evolution and has been deployed in SDI studies as mentioned in the introduction. A central question in ANT is how organizations and macro-actors come into being, and how some kinds of interactions (between humans and non-humans) more or less succeed in stabilizing and reproducing themselves. According to ANT, the macro-actors, which we come to call "the government" or "the company XY" are themselves heterogeneous networks that evolved over time. Society, agents, machines, and organizations are all effects generated in patterned networks of diverse materials (Law, 1992). The actor as network is not put in place according to a prior grand plan or design, but emerges from a multitude of associations between material and human actors through a series of translations from words into objects and vice versa (Latour, 1986; 1999). The process of networking then becomes one of adjustment, overcoming unexpected challenges, and gradual achievement of stability, where human and non-human actors become enticed, enrolled, and mobilized around obligatory points of passage (OPP) (Callon 1986; 1991; Latour, 1987). Once stabilized and irreversible, the actor-network becomes a black-box in turn linked into other actor-networks, i.e. the original actor-network becomes one punctualized actor (Callon, 1991; Law 1992). The actor-network, full-grown and boxed up (now "the government" or "the company XY"), becomes a dot within a wider landscape of integration and as such akin to the conceptualization of II as embedded in an ecology of networks discussed earlier.

However, using ANT as a lens to study the empirical world of SDI development requires a quick analytical jump over the moment when infrastructure emerges from the minute interactions between materials and humans. Looking at the development of macro-actors in hindsight, moments of translation become analytically black-boxed, so to speak. This is

¹⁹ Annemarie Mol mentioned in a research seminar ("Doing research relationally... making sense of traces, flows, and edges," Alexander von Humboldt lecture and seminar series, University of Nijmegen, 5 February, 2009) that ANT was originally not intended to mean a "theory," but rather an analytical and methodical tool box. In the discussion at hand I consider it both, theory and analytical toolbox. Following Vaughan's meaning of theory, ANT can be considered a theory, as it is a body of "theoretical tools in general, including (formulated) theory, models, and concepts" (1992, p.175).

problematic if we are faced empirically with types of actions that may or may not stabilize into an actor-network, and if we try to analyze these “embryonic” actions of a perhaps, perhaps not, some-day-to-be macro-actor. The empirical scenario I faced with respect to a given SDI or GIS initiative in the Indian cities I visited made me question as to whether I was looking at an emerging future macro-actor or center of calculation (Latour, 1987). When we trace the actors at a very early stage, how can we know, whether and which constellations will turn into actor-networks or even macro-actors? Madon et al. (2004) did adapt ANT concepts to explore a (then recent) implementation of a property self-assessment system (SAS) in Bangalore. While the study demonstrated the “interesting and insightful perspective of technology translation” (p. 269) to understand the implementation effort, the authors also concluded that it was “still premature to argue that the SAS network has been fully mobilized and that the actors are now all speaking on behalf of it” despite positive indicators in that direction (p. 290).

ANT studies take a hindsight view on network evolution – unravelling the punctualized network. ANT studies begin when translations and connections between actions have already begun to stabilize (Czarniawska, 2004; Lindberg & Czarniawska, 2006) and unravel an existing punctualized network or macro-actor backwards. A social construction of technology approach (Pinch & Bijker, 1984) is ridden with similar problems with respect to time. Whether it is the construction of a city plan (Aibar & Bijker, 1997) or the development of the bicycle (Bijker, 2010), we need to have the subject of study already in a well-developed stage along with a systematically documented history to analyse the process of network evolution. This is further complicated in some empirical contexts, where documentation is hard to come by. For example, I found many government documents in India, digital and non-digital, lacking information about dates and authors²⁰.

While the conceptualizations of II as evolving installed base or ANT provide theoretical frameworks to study II evolution *in hindsight*, they are problematic in cases of *recently emerging* II, especially where II exists more as a vision in discourse than as a visible organizing force embedded in day-to-day practice.

This led me to explore two notions: “action nets” and “boundary objects.” Building on ANT, Czarniawska (2000) introduced the concept of action net to

²⁰ Of course, this may not be unique to India. It is quite dazzling from a re-search point of view. How does one describe or explain processes, if time is always re-set to zero by empirical material available? It is arguably even more dazzling for those who request accountability in the sense of measuring progress or lack thereof through time and in the sense of identifying people to be held accountable for their actions in the first place.

conceptually tackle the issue of catching the network at its moment of emergence and to allow for the possibility that it may fall apart at any point in time. Like ANT an action net approach assumes that actions and their connections create actors (not the other way around). But action nets are different in that they are most easily observed at the very moment of emergence. The concept of action net also draws on the notion of translation – albeit in the very early stages of ANT – focusing on how words become translated into objects and actions and vice-versa (Adolffson, 2005; Czarniawska, 2000). Important to this notion is that action nets continue also when individual people are replaced and as such offers insights into processes of institutionalization. In this way action nets may consolidate into actor-networks, but not necessarily. The question is how very diverse actions can be connected to one another in the first place (Lindberg & Czarniawska, 2006).

Similar to action nets, boundary objects may also help to establish initial connections between actions across place and time (Lindberg & Czarniawska, 2006). Star & Griesemer (1989) expand upon the concept of interestment in ANT (Callon, 1986), which is the moment of translation in which an OPP cuts off his allies from other potential connections, thus making himself more central, more indispensable in his network. Star & Griesemer (1989) argue that the process of translation cannot be understood from this one central viewpoint alone, but must recognize the multiplicity of relations during the moment of interestment where several OPPs are created and negotiated. Boundary objects are material and processual work arrangements making these multi-directional negotiations possible, because boundary objects “are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites [They] have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds” (Star & Griesemer, 1989, p. 393). These objects do not cross boundaries or edges between different groups who wish to cooperate, but rather create negotiated and shared spaces between groups not only through the object’s flexible meaning (different for each group engaging with them), but also through their structure, because in each group’s use they take on a structured form as opposed to a vague and abstract form (Star, 2010).

In theorizing infrastructure and its evolution, the notions of action net and boundary object perhaps come closest to describing how integration across places and diverse actions arise at the embryonic, fragile moment of infrastructure emergence. Compared to this, the conceptualizations of II

based on studies of infrastructures that have been evolving for some time, for instance the internet, provide a window into the possible future of evolving networks as nested, tightly integrated, and deeply submerged into the nooks and crannies of human organizing and work.

However, in this study both the action net approach and the deployment of the concept of boundary objects proved unfeasible from a methodical point of view. First, is the problem of not being able to follow human and non-human actors across sites in order to observe and document, how words become translated into objects and vice-versa (Czarniawska, 2007; personal e-mail correspondence with Petra Adolffson, 2008 after my pilot study in the same year). Second, I was not able to identify, how and which object takes on the shape of a boundary object, or which procedure can be considered a boundary procedure. The lists of slums, for instance, were multiple and especially at the beginning of fieldwork, there was no systematic reason to decide which list to follow as a potential "boundary object." Furthermore, objects appear and disappear. They need to be found in different places to see how they act and connect with one another (Czarniawska, 2007). The methodical problem here lies in knowing, which objects even exist and which are only talked about. In the case of the urban II, connections between cities and municipal and state-level offices became apparent during the course of the study. However, the materiality of these connections remained obscure, partially because observation was possible in municipal offices, but for data collection at state-level I had to rely more on interviews. Interpretations had to take into consideration the construction of the II in discourse as well as in material form across sites and administrative scales and in its emergent nature pulled between past contingencies and future vision.

To explore development across the scales and between social and technical dimensions requires consideration of the survey work on the ground, data entry in offices, the intentions and standards postulated in policy and agendas, the timing of projects, and so forth. To some extent (especially in sections 4.1 and 4.3) this study may be considered an "ethnography from the future", in defiance of the widespread belief that "you cannot study something that does not exist" (Forlano, 2013). When reading Forlano, I was reminded of my conversations before each round of fieldwork when friends or family asked me, what my plan was for India this time around. I replied every time: "This time, I will really, finally find that infrastructure." About her ethnography from the future Forlano (2013) notes that it did not matter that in reality Bryant Park near Times Square had fully functioning, public wireless network since 2011. What mattered was that in the public imagination, including among telecom experts, the technology was not yet part of everyday life, but could become so in the future. This is similar to the empirical scenario in this study. Although, I could see the GIS maps on

municipal computer screens, read the documents guiding various SDI implementation efforts, and follow surveyors through neighborhoods, I could not see that the emerging or envisioned infrastructure was actually embedded in administrative processes, such as the process of property tax calculation and collection. Similar to Forlano (2013) I was engaged in an ethnography from the future.

In light of a conception of II as emergent it makes little sense methodologically to define a priori what is inside of the evolving network in terms of a laundry list of items (whether “social” or “technical” items or both) or according to a set number of properties that define what an II is. The emergent nature of II – both in terms of initial conceptualizations and in conjunction with empirical insights – becomes apparent in the ambiguities involved in delineating the network boundaries across the publications. In section 4.0, researchers using the terms “SDI” or “data sharing” come to speak for the *inside* of the network. In section 4.2, Indian NSDI strategy documents are representative of expectations *inside* of the network. While section 4.3 reduces the analytical unit to a specific GIS initiative within a larger government improvement scheme, section 4.1 is a reflection on how connections emerged between the development of different digital property databases as they became visible during fieldwork between Nirmala Nagara and other projects, associated technologies and agencies²¹. I came to call these various connections the “City Information Infrastructure (City II)” described in detail in section 4.1 to address the first research question (“How does SDI development take place in the case of digital urban property database development and what are the problems encountered?”).

These connections within the City II are manifest in discursive form (e.g. intents to collaborate in future expressed in meetings or guiding documents); other connections are enacted through reporting activities from one office to another; and yet others are manifested in digital wires and networked databases. Despite this amoeba-like nature of network boundaries across the publications, the core of the network is characterized by the implementation or intent to implement GIS beyond a single desktop application at a single office. In each publication boundaries of the network are then (re)drawn

²¹ The reader may notice that the publication in section 4.2 includes questions at the end, which are addressed in section 4.1. The reason for this chronological inconsistency is as follows: section 4.1 answers a question, which I asked early on in the research, but for which data collection and interpretation took place alongside the study of slum declaration and BSUP program implementation. The exploration of SDI development produced relevant insights only after the publication included under section 4.2 had been written. Establishing a rapport with the main people involved in SDI development across municipalities took longer. In addition, it was only later during fieldwork in Dhabunagar, that connections between different digitalization efforts in land administration became apparent and provided impetus to an analysis of the same as an emerging infrastructure beyond a single municipal administrative level.

based on respective interpretive aims and in correspondence with insights gained during fieldwork.

In order to shed light on SDI development in its emergent nature in case of the City II, it was necessary to capture the process of integration as it is taking place in the "long-now of infrastructuring." For the practitioner in SDI development this is the question Latour's fact builder concerns herself with at a given point in time: "how to spread out in time and space" (1987, p.108)? For the researcher, the question is not only, what is or what has been done to infrastructure, but also how do things and people integrate in the now and into the future? How can one analytically explore the process of making infrastructure across multiple settings and taking place across a continuum between the local (for instance, daily data entry activities in an office) and the global (for instance, the development of global standards among organizations across a continent)?

I finally converged on the concept of "infrastructuring" as analytically most useful (Karasti & Baker, 2004; Bowker et al., 2010; Ribes & Finholt, 2009). The concept derives from the first tradition of II theory by Hanseth, Monteiro and others, which I discussed earlier. Because infrastructure does not happen on command on a greenfield, it makes sense to speak of "infrastructuring" rather than infrastructure. Conceptually, the notion of infrastructuring does not separate between "infrastructure," on one hand, and "development of," on the other²². Infrastructuring refers to the continuous, often invisible work in the background of what we may at first perceive to be "the" infrastructure: the wires, railroad tracks – and in the case of II – digital facilities and computers (Bowker et al., 2010). Infrastructure thus becomes viewed as the "creative activity that can be described as design," where design is understood "as any motivated, transformational activity that individuals or groups perform" (Pipek & Wulf, 2009; 457). The lines between design versus implementation versus use are blurred. The conceptualization of infrastructure as a gerund allows to explore the long now of infrastructure, its evolution embedded in historical contingencies (organizational and technical) and at the same time stretching into and shaping the future of work practices (Karasti & Baker, 2004; Bowker et al., 2010; Ribes & Finholt, 2009).

Development of II takes place in a field of tensions between the past, present and future. Infrastructuring as transformational activity means "that it induces a change that is intended to have a longer-lasting effect" (Pipek & Wulf, 2009; p. 457), and is arguably even more important to understanding the many projects of digital II development that are only in the initial stages and emerging. Based on these understandings, Ribes & Finholt (2009)

²² Nevertheless, I write "SDI development" throughout this thesis, because Spatial Data Infrastructuring would be too confusing in other sections of the thesis.

propose a framework to study the long-term endeavour of developing II. The framework tackles the question of how things and people become integrated (or not). The authors developed the framework specifically for the study of recently emerging II, because “many of these projects are still in the early stages of planning development. Whether the resources and work necessary for permanent implementation and adoption will materialize remains unclear” (p. 376).

The authors draw on the concept of the “long now,” which is a “view of technology development that brings multiple concerns, and matters of organisation and technology, into the single frame of action that participants [in the development of II] encounter on a regular basis” (p. 391). The framework rests empirically on four cases of e-infrastructure (a more generic term for II used by the authors) development. In each case participants are scientists from diverse disciplines and working in dispersed settings. Each e-infrastructure is to serve this multitude of scientific communities. The problems involved in the development were expressed as “tensions” by participants themselves. To characterise the “problem space” of II development the authors frame these tensions along two axes: *scales* and *concerns*. To explore temporal dimensions multiple *scales* of action are considered: the technical work of creating and deploying durable resources (enacting technology), the human work and organizational arrangements (organizing work), and the practical work of institutionalizing through policies and reports (institutionalizing). At each scale, Ribes & Finholt discovered a persistent set of *concerns* for long-term sustainability: ensuring that participants contribute (motivating contribution), coordinating among different scientific traditions and multiple goals (aligning end goals), and ensuring that resources are adopted by present as well as future users (designing for use). The interrelated tensions in the development of II are positioned in the space defined by the two dimensions, *scales* and *concerns*. The framework is especially applicable in the empirical context of my study, where many projects are being implemented state-wide, often under different labels and funding frames.

With respect to the City II case in my study, the framework also allows to recognize aspects of top-down, managerial approaches, which – whether theory agrees or not – characterize real-world development efforts. While theories of II discussed above explain, why long-term design plans are too ambitious given the empirical realities of II evolution, these plans are at the same time considered necessary by participants to guide and evaluate the effort, despite facing future shifts and drifts that II development undergoes as it evolves.

Considering differences in various scientific communities and disciplines to uptake the technologies of the e-infrastructure the framework shifts into focus also the work processes and practices of different communities in relation to a promoted technology. In Ribes & Finholt's (2009) cases, communities are the general science domain, e.g. environmental researchers, whereas constituencies refer to particular groups tied to a project, for example hydrologists and environmental engineers. The latter can shift as new organizations become enrolled in the project over time. The tension finds expression in participants asking, who the community is and what it wants. We need to design technology and practices today for tomorrow's users, who are at the same time a moving target.

In case of the City II this relates to the tricky question of boundaries – or rather the blurriness of boundaries - of and around an II. In SDI, for instance, we may have a number of stakeholders involved in setting policies and standards, and these can be identified as forming the SDI initiative. But the end users are multiple, vaguely defined; and in the present it is often unclear who will become enrolled in the future either as data provider, or policy maker, or user.

In sum, Ribes & Finholt's (2009) framework served as a useful conceptual lens for the interpretation of empirical material about the City II to answer research question one (How does SDI development take place in the case of digital urban property database development and what are the problems encountered?), because it aligns with the theoretical understandings outlined in section 3.1, but also because it explicitly interrogates how tensions between past and future, between present activities and future visions are expressed by participants themselves through interviews. This made the framework applicable for interpretation also, because of the empirical material at hand. In the case of the City II a lot of my material was derived from more formal interviews with those who implement GIS, especially at state-level rather than longer term observation or repeated visits to offices.

The discussion so far has made a move from conceptualizing II as large-scale integrated network to capturing II in its processual nature and as infrastructuring between past and future. The move from "what is II" when we take a hindsight look based on knowledge about existing large-scale networks to "how II becomes" has taken us from the scale of an ecology of networks to the world of alliances emerging between material and human actors in the embryonic moments of infrastructuring. But, so far, we have for the most part remained inside of the network in conceptual terms, while recognizing its emergent character.

The logical dilemma of remaining inside of the network is that the things, people and actions outside of the network become easily viewed as the obstacle to network expansion and integration. The outside comes to be considered as “those who still need to be enrolled in the network” or else they are considered simply as one lump of resistance. This is Latour’s (1987) criticism of the model of diffusion and what he calls the principle of asymmetry: there is appeal to social factors only when the true path of reason has been ‘distorted’ but not when it goes straight” (p. 136). In this case society emerges as a concept in as far as it poses resistance (or not) to the movement and spread of a fact or a technology. Theorizing II becomes more complicated not only “when one begins to investigate large scale technical systems in the making,” but also when one begins “to examine the situations of those who are not served by a particular infrastructure. For a railroad engineer, the rails are not infrastructure but topic. For the person in a wheelchair, the stairs and doorjamb in front of a building are not seamless subtenders of use, but barriers” (Star, 1999, p. 380).

Bowker & Star (2000) problematize ANT studies in so far as “the actors being followed [by sociologists of science] did not themselves see what was excluded: they constructed a world in which that exclusion could occur” (Bowker & Star, 2000, p. 48). Following the actors then also means sharing the actors’ blindness in the sense that we do not see, what becomes excluded when actions connect, and actors arise (Bowker & Star, 2000). What becomes blended out is the “not (yet) infrastructure” and questions about to whom is something an infrastructure or a barrier (Star & Ruhleder, 1996). A similar problem arises in Ribes & Finholt’s framework. The tensions identified from the points of view of participants involved in e-infrastructure development foreground the nature of II as a process and with view towards the future, but for the most part take a perspective from within the network. From an insider perspective it is already impossible to think or act otherwise, other than the course of direction envisioned for the future, a principle Bowker and Star refer to as “convergence” (2000, p. 49).

In section 4.1 of the thesis the practices of claiming, using and “owning” urban land²³ before GIS implementation (the outside of the network) are only tangentially addressed and only as obstacles to implementation, precisely because the account reflects a perspective from inside the network. The interpretation of the City II development in section 4.1, despite its emphasis

²³ Insights on access to, claiming and using land were mostly drawn from empirical material about slum identification and improvement processes, because these are implicated by and constitutive of existing regimes of land claiming and ownership. In other words, to gain insights into land related issues one need not necessarily only talk to the tax revenue department or planning agency, but following processes and contestations around the concept of slum provide ample insights into broader issues of accessing, claiming, using, and owning land.

on emergence, still implicitly and very subtly sneaks in the assumption that infrastructure is first *being* "built and maintained, and then sinks into an invisible background" (Star & Ruhleder, 1996, p. 112). In a next interpretive move it is necessary to foreground and interrogate the (from the point of view of the II) "invisible background" and the interplay or contradictions arising between the SDI development effort and the practices and organizing into which it is supposed to be transplanted. If irrationality of the outside is defined by those inside a network who consider their path to be the rational one (Latour, 1987) the theoretical issue to be tackled in a study on II development involves a move towards more symmetry between the *inside* and the *outside* of a network.

At this point the question of setting another boundary arises, namely around "the outside" of an emergent network. Drawing the boundary around "what SDI makers in potentia" (the outside of the network) are doing is not arbitrary, but it lacks a core term around which to arrange actors and relations (such as SDI or GIS), a core term (the magic concept introducing the thesis), which allowed to set analytical boundaries despite II's emergent nature in interpretations pertaining to the inside of the network. Setting boundaries around the outside was influenced by methodical issues, such as access to different sites as well as contingencies that arose from the context of the larger research program. To narrow down the "outside of the network" the context of this research program provided guidance in the first instance. For example it provided the frame to focus on the urban arena (rather than rural). This is evident in section 4.0, where the proposal for future research directions refers to urban planning practice in conjunction with my first empirical insights from Indian cities. Similarly, the focus on slum declaration and listing in poverty alleviation schemes (sections 4.2 and 4.3) was influenced by the focus of the larger research program on urban deprivations, but also due to initial problems in gaining access to municipal departments, including the so called "GIS department" in Mugdali and revenue offices²⁴.

Foregrounding the invisible background and allowing for a perspective from the outside (or the "before SDI" if we follow the futuristic lines envisioned through the perspectives inside of an evolving network) is the aim of research question two formulated in the introduction: What characterizes classifying practices in the case of slum declaration (under BSUP) and in how far do these match the core tenets of SDI or not?

²⁴ I want to note here that the relative ease of access to "slums" and related administrative offices for me, a foreigner, a researcher, influenced interpretations regarding possibilities for participation and negotiation in non-SDI based practices. These interpretations were influenced also by the experience I personally had in the slum district office in Mugdali. It was the Assistant Executive Engineer, a person consulted by everyone from Commissioner to "slum dweller" and thus very busy all day long, who helped me find a translator when several other options failed.

In the following section, I will explain, how classifying practices help to stretch across the shifting boundaries between inside and outside the SDI network. An important notion in the following interpretive moves is the conceptualization of II as large-scale classification systems and the notion of an infrastructural inversion.

3.2 ... via an infrastructural inversion: classifying practices inside and outside of the network

In research question two (What characterizes classifying practices in the case of slum declaration and in how far do these match the core tenets of SDI or not?), the focus is on classifying practices as delineator of the “outside of a (SDI) network.” One reason for this final formulation is that across interpretations during the course of this study classifying practices retained relevance beyond empirical or analytical boundaries based on specific sets of actors, rationales, and their relations (e.g. those involved in City II versus GIS property mapping under Nirmla) or processes (e.g. slum declaration across improvement schemes versus the framework of BSUP). However, this was also played against the literature and informed by earlier conceptualizations of SDI as classification systems. I will therefore in the following paragraphs elaborate on three moves that explain (and justify) from a theoretical perspective, why focus in research question two came to rest on classifying practices and how to define these.

The first move links SDI to the notion of II as large-scale classification systems developed by Bowker & Star (2000) and based on a study of the International Classification of Diseases (ICD). A key idea in this approach is to understand the development of II by exploring the work of classifying. A driver behind this work in II development is the aim of developing formal classification systems. Formal classifications are “spatial, temporal, or spatio-temporal segmentation[s] of the world” each with a consistent, unique classificatory principle in operation, mutually exclusive categories, and complete with respect to the items, actions or areas under consideration (Bowker & Star, 2000, p. 10-11).

The underlying ideal here is a mode of representation, which Mol & Law (2002) call the “classificatory system.” As an (ideal) mode of representation, the classificatory system seeks to order the complexities of the world. Orders in this sense “do not simply expel the complex and chaotic. In addition, they insist that what belongs to them is drawn together and properly assembled. No element may hold back, and what is inside must be named, accorded a place” (pp. 13–14). In ordering, the aim is to assemble elements to fit into a larger scheme. The word “order” came into modern thought from architecture, where it denotes a “whole in which all parts fit each other and

none could be replaced without destroying the harmony, a situation that no change could improve" (Baumann, 1995, p. 128).

The goal of gaining an all-inclusive overview does not mean that the classification is expected to include and represent all of reality. The underlying rationale of ordering is to assemble elements in such a way that the representation of the world is all inclusive with respect to certain application domains (e.g. land use planning) and where outcomes of assemblage are representative for a specific aspect of the world (e.g. land use).

The classificatory system also contains a hierarchical element. A list, table, or database created according to a classificatory logic "presupposes a single and conformable world ... and makes big cages that are then subdivided into smaller ones" (Mol & Law 2002, p. 14). An example, especially relevant in the context of (cross-organizational) GIS database development, is land use classification. The aim is to include every possible land use, and this is done through hierarchical nesting of land use categories. The first level may be residential, industrial, commercial, and open space. The second level is low- and high-density residential areas, light and heavy industry, and so forth. The classification insists on properly assembling these elements and being all inclusive and hence representative of the world with respect to land use.

This ideal of a classificatory system drives II development, because it allows for standardization of individual categories, their meaning, and their relations. Standards are agreements between people and organizations, for instance, on how to classify across different sites and time. The principles by which classifying choices are made have to be captured in material form and discourse in a way that allows choices to be repeated again in another place or by another person to be able to attribute meaning to these categories at a different site and time.

The idea here is that if I look at a group of apple trees and decide to categorize it as "deciduous forest" based on the number and density of trees (sub-category of forest – a smaller cage in Mol and Law's terms), and group composition in terms of types of leaves (sub-category of tree – a smaller cage within the cage), another person will (based on the same criteria) categorize the group also as "deciduous forest." And not only that, another person looking at a group of cherry trees in a different place far away will tick the box "deciduous forest" on a survey sheet if the group of trees displays the standard criteria of the category "deciduous forest."

As such, standards span across communities of practice and persist over time making things work together over distance and heterogeneous metrics, a

property which makes a standard difficult to change, but at the same time an essential ingredient to share information, collaborate and coordinate across time and space (Bowker & Star, 2000; Meum, Monteiro, & Ellingsen, 2011; Ellingsen, Monteiro, & Munkvold, 2007). Lately, information technologies are seen as a way to improve standardization and thus collaboration across sites. But the basic nexus between standardization of categories, definitions, and their relations, on one hand, and the ability to transport knowledge across time and place is in itself not new. For instance, new systematics of classifying in biology were developed when navigators started bringing home specimens from the “ends of the earth” specimens, which were necessarily different from the “folk classifications”, understandable only in given localities (Hacking, 1992, p. 187).

For infrastructure to grow beyond a given locality, to achieve its property of being local as well as global and to span across agencies, places, and different communities of practice, classification systems and principles need to *become* standards that cut across organizational and technological boundaries. The ideal of a classificatory system drives these processes of standardization, and through time “standards, categories, technologies, phenomenology are increasingly converging in large-scale information infrastructure” (Bowker & Star, 2000, p. 47).

The expectations reflected in Indian NSDI documents (section 4.2) as well as survey and organizational mechanisms to map properties (sections 4.1 and 4.3) illustrate that SDI development is driven by the ideal classificatory system as mode of representation. In sum, large-scale II, including SDI and cross-organizational GIS, are closely allied with the notion of codified digital knowledge captured in formal classification systems, precisely because they seek to support integration and collaboration across diverse settings (Homburg, 2008; Meum, Monteiro, & Ellingsen, 2011; Stalder, 2011). “If large networks, and large networks of networks, are going to operate smoothly, they must be convergent and aligned. In technical terms this means standardized” (Hanseth & Lundberg, 2001, p. 360).

From this perspective formal categories and formal classification systems (i.e. standards) are seen as enabling (coordination, collaboration, etc.). Drawing on Winograd’s work (1994), Orlikowsky (1998) illustrates that this view arises mainly when one takes the design perspective. This perspective, I would add necessarily involves a visionary aspect, a look into and towards the future.

This leads to the second interpretive move informed by Bowker & Star’s conceptualization of II as large-scale classification systems (Bowker, 2000a, 2000b; Bowker & Star, 2000). Their research, specifically a historical analysis

of the ICD, illustrates that II development does not adhere to the ideal of a classificatory system in practice. The creation and maintenance of complex classifications, the decisions on how to categorize and the financial, skill, and moral dimensions converge in day-to-day work practices across various sites constantly making and re-making the infrastructure. Only over time do these politics and histories that make formal classification systems sink into routines, and become invisible and naturalized, and thus endowed with the feel of objective, factual knowledge. It is not only the unambiguous hierarchies of a classificatory logic, but also informal decisions, politics and histories that become hardwired into digital databases (Bowker et al., 2010, p. 105). In studying the development of large-scale databases and standardization "the trick is to question every apparently natural easiness in the world around us and look for the work involved in making it easy" (Bowker & Star, 2000, p. 39).

The work that makes things easy does not function according to the ideal logic of a classificatory system or an Aristotelian logic of defining (decreeing) individual categories. According to the Aristotelian logic the decision to place an item in the category or not "works according to a set of binary characteristics that the object being classified either presents or does not present" (Bowker & Star, 2000, p.62). Another logic underlying classifying practice is based on prototypes, where we do not deal with binary characteristics of an item to decide on its placement in a category, but where we call on examples, evoke broad pictures in our mind of what item x is like and consider placement based on analogy and examples (Bowker & Star, 2000; Douglas, 1992). According to this theory a classification is much fuzzier than binary logic would assume.

Mol & Law (2002) make a similar point when juxtaposing the classificatory system with other representations of the world that do not have to seek to impose a single order onto the world. For the latter, Mol & Law (2002) give the frequently cited example of Borges's Chinese encyclopedia that divides animals into odd categories like "stray dogs" or those "drawn with a very fine camelhair brush." This list does not adhere to a classificatory system as previously outlined. According to Mol & Law (2002) "items in [such] a list are not necessarily responses to the same questions but may hang together in other ways, for instance socially, because [such] a list may be the result of the work of different people who have each added something to it" (p. 14). That is, "they assemble elements that do not necessarily fit together into some larger scheme [and] they make no claims to inclusiveness" (p. 7). Such a list only groups together without relying on any single logic of ordering. While, Borges's Chinese encyclopedia is an extreme juxtaposed against the classificatory system ideal, Mol and Law argue that different modes of ordering coexist in the world.

The example of categorizing groups of trees, which I gave earlier, adheres in the first instance to the Aristotelian binary logic. However, it is likely that the two categorizers ticked the survey boxes also based on “something else,” for example experience in surveying trees in their respective areas and deciding that even if there is a pine tree mixed into the group, it can count as “deciduous forest” given a certain purpose at hand. Formal classification mingles with more vernacular and situation-specific decisions on how to classify an item.

Different modes of ordering also characterize the work involved in developing large-scale classification systems. Bowker and Star’s definition of classifying practice acknowledges that the day-to-day work of classifying is not purely based on the ideal logic of a classificatory system, nor does a person assigning items into a given classification system work solely on an Aristotelian binary code. Classifying practice refers to how people categorize the objects they encounter in everyday situations, *including* formal classification schemes. Part of reading classifications is understanding the nature of these encounters, and the interplay between vernacular and formal systems” (Bowker and Star, 2000, p. 59, emphasis added). Resistance by designers and users of II also changes the networks of classification and standards themselves, because of the multiplicity of people, things and processes involved. Classifications and standards (inside of a network) are never locked in for all time. Rather than being the only rational path, II development itself is changing with political and cultural context, a fact easily forgotten, because “large-scale classification systems are often invisible, erased by their naturalization into the routines of life. Conflict and multiplicity are often buried beneath layers of obscure representation” (Bowker & Star, 2000, 47).

Research by Ellingsen, Monteiro, & Munkvold (2007) and Meum, Monteiro, & Ellingsen (2011) provides further evidence for standardization as a “pendulum movement” between global classifications and local practices: as a co-constructed practice. Their work is based on studying, how nurses in Norway adapt to and implement standard health classifications and health care plans via a new electronic system replacing earlier paper based systems. Standardized terminologies were to ensure “consistency of meaning across time and place to enable large-scale planning for local users, for national health authorities, as well as international health organizations. Rather than local work practice being an obstacle to standardization, the research shows that standardization is a socially constructed negotiation process, with nurses adding to and adapting standard categories as well as re-configuring local classifications. The authors conclude that “instead of distinguishing between formal and informal classifications, we must look at how these constitute each other” (Meum et al, 2011. p.119).

While a perspective on formal classification systems from a designer perspective may overemphasize their enabling nature in terms of increased collaboration and information sharing across time and space, the local user perspective may over-emphasize their constraining character. Instead, both formal, standard as well as informal, situated categories are always constraining and enabling depending on circumstances (Orlikowsky, 1995) and are co-constructive of each other.

In sum, although II may thrive towards a formal classificatory logic and standardization, the practices involved in this work are always comprised of an interplay between a formal, standard and a situated, informal way of classifying. "The formal and informal are completely mingled in infrastructure ... [and there is a] range of ways classification systems may be fuzzy or logical, reflective at once of bureaucratic concerns, scientific grounds, formal considerations, and cognitive theories" (Bowker & Star, 2000, pp.54 and 57). Making visible this work of classifying and the work done by classifications is the core idea behind an infrastructural inversion as a methodological approach to the study of infrastructure (Bowker & Star, 2000). An infrastructural inversion entails a kind of figure-ground gestalt shift in two main ways that are relevant to the third interpretive move behind research questions three and four.

First, recognizing that local and global, situated and standard, informal and formal categories and classifications intermingle in the work that makes II means recognizing that II are not designed from nowhere (Suchman, 2003). II as "[s]ystems of classification form a juncture of social organization, moral order, and layers of technical integration" (Bowker & Star, 2000, p. 33). In other words, the boundary between "policy" and "database" dissolves. II are not politically or morally neutral networks of databases, but socio-political constructs like any other classification system (spanning between formal and informal, standard and situated).

A fine-grained analysis of II as classification systems demonstrates not only how they represent the world "out there," but also the organizational context of their application, as well as the political and social roots of that context (Bowker & Star, 2000, p. 61). This implies that the representations produced and modes of representation embedded inside the network are not necessarily more factual, objective or accurate than others. In the first instance then, an infrastructural inversion calls into question assumptions about greater legitimacy of codified and digital knowledge increasingly widespread in a digitalized world (Tsoukas, 1997).

Especially in the empirical context of slowly emerging SDI an infrastructural inversion explores "[w]hat is classification like before the heterogeneous

material is discarded from one emergent specialised domain after another and made irrelevant by classificatory decision" (Douglas and Hull, 1992, p. 1). In the final instance, such analysis provides a basis to discuss who may or may not be served by an (emerging) infrastructure and whose interests are left out from its development (Bowker & Star, 2000) before its classification systems turn into institutions that "rouse our emotions to a standardized pitch on standardized issues" (Douglas, 1986, p.92), that is before the institutionalized infrastructure performs as closed macro-actor.

Because the work of classifying is ubiquitous and not unique to II an infrastructural inversion opens the view into a variety in representation systems that other cultures may have and the fragile networks these classification systems underlie (Bowker & Star, 2000). The approach permits asking questions about, what alternatives become included or excluded in the representations, which later (may or may not) come to be considered as "permanent facts."

Secondly and closely related is the value of an infrastructural inversion for its insistence on the work done, the practices of infrastructuring. It does not start or even arrive at a list of non-human and human actors that constitute the network. Rather, the notion of an infrastructural inversion recognizes that classification systems and practices are ubiquitous and not unique to the network. In the context of this study, this provides a common denominator to compare the inside and outside of the network without sticking to a pre-defined laundry list of network elements. Classifying practices characterize both the development of GIS databases, the standardization involved in developing GIS databases that go beyond stand-alone desktop applications and file systems, as well as the classifications of people and areas on paper, in excel files or powerpoint tables in the context of urban administration. While taking into consideration the differences in these technologies analytical emphasis does not in the first instance lie on a list of "tools" or "wires" as main constituents of the infrastructure or – if lacking – as the "not infrastructure."

Inside an evolving II as well as outside, people negotiate between situated categories and standard categories, draw on plans and designs for guidance, but renegotiate the two. In this way "classifying becomes organizing" and not something added on after we organize (Bowker & Star 2000; Douglas & Hull, 1992; Suchman, 1987; Tsoukas & Vladimirou, 2001). Neither are the classifications involved in infrastructure free of ambiguity, nor is the context in which infrastructure grows - or in some cases is supposed to be transplanted into - void of classifying practices that negotiate between standard and situated categories. From this methodological perspective and its theoretical antecedents in Goodman's work, we are in neither case

“allowed to invoke natural similarity to explain the emergence of categories or to explain how their meanings are entrenched” (Douglas & Hull, 1992, p.5).

Classifying practice serves as a common denominator between SDI and non-SDI, because we always “use a set of categories (whether formal or informal, standardized or situated)...to do or understand something” (Orlikowsky, 1995, p. 73).

Through these three interpretive moves via II as classification systems and the infrastructural inversion such view entails it is no longer necessary to draw a static, black line around the network or to list what elements are in and out at the out-set of the research. The outside needs no longer to be read as obstacle or realm of resistance to developing II, but as a sphere on equal par with the inside in terms of practices (namely classifying practice) involved as well as being no more or less rational than the forces driving II development. At the same time classifying practices provide a conceptual focus among the obviously many things that can be done by the “makers and users of SDI in potentia.” This now explains and justifies asking the second research question (What characterizes classifying practices in the case of slum declaration and in how far do these match the core tenets of SDI or not?), which essentially entails a look towards SDI rather than from within SDI onto a world that may too quickly appear as obstacle to a desired path.

Douglas & Hull (1992) conclude from seminal writings on classification that the “theory of knowledge ... needs an account of community interest in stable categories as well as in precise categories” (p. 11). Discussing the possible implications of SDI development in Indian urban governance needs to take into account interests in both stable categories (or formal classification systems) as well as in situated categories and the ensuing ambiguities and instabilities across space and time. Because classification systems always enable or constrain depending on situation, it is necessary to explore “what is enabled and what is constrained in what circumstance” (Orlikowsky, 1995, p. 75).

Now that both SDI and non-based SDI based practices have been positioned theoretically to explore both in themselves, it is now necessary to establish the circumstances under which these practices take place. As mentioned in section one, classifying people and land does not take place for its own sake, but has larger purposes in mind.

In the final conceptual section 3.3 I will sketch out the “circumstantial frame” around government improvement schemes as basis for a comparison between SDI and non-SDI based classifying practices. I will refer to a final

concept introduced by James Scott (1998), namely legibility making, because it offers a useful point of departure to explore the interests behind standardized, unambiguous knowledge and situated, ambiguous knowledge in the context of government improvement schemes.

3.3 ... towards legibility making between state and urban society

In these final interpretive moves, I discuss my use of Scott's (1998) concept of legibility making in the interpretation of material addressing research question three (How do SDI-based versus non-SDI based practices of legibility making work out in reaching the aims of their respective government improvement schemes?). This concept continues the line of thought elaborated on in sections 3.1 and 3.2, and serves as a common denominator to compare both slum listing (non-SDI based practices) and GIS property mapping (SDI-based practices) on equal par without assuming that one provides "better" knowledge than the other. It relaxes the fixation on classification in the sense that it involves a variety of representations that strive towards standardized, unambiguous, and perhaps as such most importantly permanent knowledge – permanent in the sense of providing a basis for future steps and decisions. In addition, the concept of legibility making serves to frame classifying practice in relation to government improvement schemes and thus goes beyond the production of knowledge in and for itself. In the final instance, an interrogation of non-SDI based and SDI-based practices by employing the concept of legibility making brings into focus state-society interactions in urban governance and creates a basis to discuss possible implications of SDI development in Indian cities with reference to recent literature from anthropologies of the state which have amplified Scott's (1998) analytical frame.

It is within the historiographical frame established in the introduction of this thesis and from the perspective of II development as large-scale classification system discussed in the sections above, that one finds a continuity between SDI development and a "set of classificatory practices defining the modern state and later the modern corporation" (Bowker & Star, 2000, p. 132). Both science and bureaucracy strive for systematic classification. The former strives towards a classificatory system logic and demands clear and recognizable rules of classification (standards) in order to enable social coordination (Starr, 1992). In this sense, SDI development is a historical continuation of older practices of knowledge production that have been deployed by the state to make its society and territory legible. Within this larger framework, classifying practice within SDI is conceptually akin to listing slums in terms of improvement schemes requirements. The latter involves the classification of the city and its residents into slum and non-slum

areas and into slum and non-slum residents albeit deploying paper and dispersed desktop technologies rather than GIS.

In terms of underlying rationales both GIS property mapping (SDI) and slum listing (non-SDI) are reflective of a government rationality that emerged during the 16th century and was characterized by the state's need to know its population and territory through a set of techniques, including polls, observations, surveys, record-keeping, and censuses (Foucault, 2006). In "Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed" Scott (1998) analyzes a range of state-driven improvement schemes across the globe through the lens of legibility. Legibility making refers to processes through which the state gradually gained a handle on its population and territory through the production of knowledge, which enhances the capacity of administrative cadres to "see" the territory and improve the welfare of the people (Scott, 1998). These processes are manifold, but "[i]n each case, officials took exceptionally complex, illegible, and local social practices, such as land tenure customs or naming customs, and created a standard grid whereby it could be centrally recorded and monitored" (Scott, 1998, p.2). Underlying efforts of legibility making is the notion of official knowledge as a permanent, unambiguous, standardized, and comprehensive knowledge, and as such a simplified version of reality (Carson, 2011; Scott, 1998). This is where we find a close kinship between II's need for knowledge production striving towards the classificatory system logic (unambiguous, without overlaps, inclusive as outlined in section 3.2) and the standardization of principles underlying such classifications. As in the case of II development for collaborative work in health care or other domains, standardization and increasing permanence of knowledge (for example the definition of a category remaining stable through space, but also through time) allows knowing across distance and time. The production of knowledge based on standards, for example surveys based on standard geographic coordinates and repeatable procedures, thus produces an appearance of transparency, of being able to see the reality of a distant place without being there (Marlor, 2010). The reality of a given locality becomes thus knowable to a distant center – in Scott's (1998) scheme, to the state apparatus, which administers a large territory and society from afar.

Mol & Law (2002) discuss maps as another mode of representation that creates closed orders, besides the classificatory system. Both maps and classification systems developed and deployed by the state have been and continue to be sources of and a means to exert power, control, capital accumulation, devices to form the administrative territories of nation states and to colonize distant lands (Harley, 1989; Harvey, 1989; Kitchin, Dodge, & Perkins, 2011). In the service of the state or other colonizing and conquering agents cartography has come to be seen and developed as a means by which

the "surface of the earth is represented as faithfully as possible. The skill of the cartographer is to capture and portray relevant features accurately. Cartography as an academic and scientific pursuit then largely consists of theorizing how best to represent spatial data" (Kitchin & Dodge, 2007) and to get as close as possible to a "true representation" of reality. As early as 1596 the English surveyor Radulph Agas emphasized the utility of private estate maps in a treatise "A Preparative to Platting of Landes" as having three advantages over textual estate descriptions ("Cartes Parlante"), namely: increased precision of location, efficiency of land management, and permanence of record (Kain & Baigent, 1992). To this day, these key motives are reflected in the portrayal of cartographic technology development as a normative history of progress striving towards ever increasing accuracy, permanence and comprehensiveness of the maps' contents (Kitchin, et al., 2011). "Improved accuracy, increased detail and more current ... information" are the hallmarks of cartographic progress (Monmonier in Kitchin, et al., 2011, p. 123). And we find them again, in the promises attached to the development and use of new spatial technologies, including GIS deployed for land administration in recent years. Dale & McLaughlin (1999), for example, emphasize the usefulness of GIS to store locational elements of data about land as points, lines, and polygons, that can be displayed geometrically with attributes referenced to a precise spatial framework, such as Cartesian coordinates or grid cells. The value of such information would then depend upon the quality of the data, that is especially on the "extent to which they are up to date, accurate, complete, comprehensive, understandable, and accessible;" the opposite (poor quality data), it is argued, will almost "certainly result in bad decision-making" (Dale & McLaughlin, 1999, p. 92).

The power of maps to support control and knowledge from a distance lies precisely in the standardization of cartographic techniques, for instance reliance on Cartesian representation, which enabled maps to become "immutable mobiles" in Latour's (1990) term and to govern from a distance. Ingold (2007) likens such maps to the lines of a network that seek to survey, map out and draw a boundary around newly discovered territory ahead of travel. Maps as dots and lines of a network are built in advance to ease transport, the occupation and administration of a territory from afar. Knowledge in this framework of modern thought is "assembled by joining up, into a complete picture, observations taken from a number of fixed points...this is how the surveyor proceeds in the construction of a cartographic map, ...knowledge is integrated not by going along but by building up, that is by fitting ...site-specific fragments into structures of progressively greater inclusiveness" (Ingold, 2007, p.88).

This knowledge framework underlies land and cadastral maps. They are one of the examples in Scott's work (1998) that illustrate the characteristics of

legibility making. Local practices of land use and ownership are not only complex and often illegible to outsiders in terms of spatial arrangement, but also flexible through time. Land maps and particularly cadastral maps were designed to not only *standardize* the socio-spatial relations around land holdings across different localities, but also to trace land distribution and ownership through time promoting a *permanent* knowledge, for instance through the creation of patrilineal last names that allowed tax authorities to track owners across generations. In its aim of assigning one piece of land to one owner, the cadastral survey emphasizes *unambiguous* knowledge, as well as *comprehensiveness* in terms of coverage of territory and types of tenure and land holdings.

The “project of legibility” as a way of knowing thus entails simplifications of local particularity and complexity in order to provide a distant center, for instance a state official, with a “synoptic view” of many diverse situations with the aim also of providing permanent knowledge that holds across generations (Scott, 1998).

Legibility making not only simplifies the reality that it seeks to depict, but also has the power to alter the same with long term and often unpredictable effects, especially if backed up by state force through legal means and more so under authoritarian regimes (Scott, 1998). Kind-making (that is classifying) is also world-making (Hacking, 1992). The aim of knowing, where and how to locate individuals, their conduct, and qualities, the aim to make people and territory legible establishes presences and absences (Carson, 2011), not only in and through classification and related bracketing of inconvenient complexities, but in effect by re-ordering reality.

Dirks’ (2001) analysis of the British archive provides an example of these processes in Indian history. The archive not only “encoded British anxiety that rule was always dependent on knowledge,” but it “performed that rule through the gathering and application of knowledge” (p. 123). Dirks’ argument is that the explosion of empirical knowledge during colonial rule naturalized the caste system for explaining Indian social relations as a whole²⁵. Indeed, Dirks argues that the caste system as it is known and practiced in India today is a creation of colonial governmentality, or in the terms of Scott’s (1998) conceptualization, a result of the colonial power’s need for and enactment of legibility.

²⁵ The notion of caste is inherent to pre-colonial Indian philosophy. Dirks’s argument is that colonialism strongly influenced the structuring of Indian society specifically along the lines of caste. To this day, caste remains to some degree flexible as people may move or be moved into new categories, e.g. in response to government programs and election seat reservations (last sentence: from researcher’s interviews).

Scott's (1998) work is abound with evidence of how the legibility project turns forests, cities, and rural socio-spatial arrangements into what he calls "landscapes of control and appropriation" with detrimental effects or outright failure of improvement. "Where such schemes run into trouble, sometimes catastrophic trouble, is when they encounter a recalcitrant nature, the complexity of which they only poorly comprehend, or when they encounter recalcitrant human nature, the complexity of which they also poorly comprehend" (Scott, 2012, p. 37). The complexity of local situation and context is navigated and understood through what Scott (1998, 2012) refers to as vernacular knowledge. One of the many examples Scott gives is the knowledge of local farmers accumulated through ongoing experimentation, and an intimate understanding of environmental and social relations of a particular place. Ingold's example of the sketch map, which he juxtaposes to maps constituted as lines of a network, is useful here. A sketch map does not depict dots joined up by lines, but rather fleeting and situation specific "paths of travel." It reflects lines of movement through a terrain rather than making a claim to represent, bound or categorize a certain territory.

Knowledge underlying a sketch map, knowledge drawn together when using a map in navigation, or the kind of knowledge embedded in the practices of mapping, becomes accumulated through wayfaring, the movement through a territory: "the knowledge we have of our surroundings is forged by the very course of our moving through them, in our passage from place to place and the changing horizons along the way... [it is] the integration of knowledge *along* a path of travel" (87-88, emphasis in original). Such maps or mappings are constantly evolving and embedded in situation and practices of making, using, and reading maps, linked into other signposts along routes of navigation, and thus of a fleeting nature (Kitchin & Dodge, 2007; November, Camacho-Hübner, & Latour, 2010).

This notion of knowledge integrated through travel and movement does not present itself as a basis for (think of knowledge aka information as decision input) or as outcome of an action (think of knowledge aka information as indicator to evaluate outcomes). It is more akin to a "knowledge-in-practice," that is internalized and personalized, and drawn upon when needed, and difficult or impossible to describe to others (Schoen, 1991, p.54). Ingold refers to the ways of knowing as we inhabit and move along in the world as "inhabitant knowledge."

In Scott's (1998) analytical frame, this vernacular knowledge is assigned to the non-state, the "local." He thus makes a basic analytical differentiation between official knowledge that is of the state, on one hand, and vernacular knowledge embedded in local practices of citizens, on the other: "Each undertaking... exemplified a *pattern of relations* between *local knowledge* and

practices on one hand and state administrative routines on the other.... In each case, local practices of measurement and landholding were “illegible” to the state in their raw form. They exhibited a diversity and intricacy that reflected a great variety of *purely local, not state, interests*” (Scott, 1998 p. 24; emphasis added).

In Scott’s (1998) analytical scheme then resistance to the state’s legibility project arises from the local non-state realm of vernacular knowledge, for instance when those who are being classified and mapped resist. One aim of legibility making in the context of government improvement schemes is to identify target groups: target groups for affirmative action policies, target groups to improve via punishment (under a given law), or target groups to be brought into a standard grid of society to administer health and educational services, and so forth. The listing of slums – that is the classification of the city into slum and non-slum – is an effort of legibility making by the government, namely to identify target populations for various improvement schemes (although this official goal is appropriated for various other purposes).

But as discussed in the previous section, classifying practice is never only either formal or informal. Perhaps even more so in government improvement schemes it involves political decisions that impact people’s lives. Both in II development or on a paper list “classification is political choice rather than some unconscious expression of social or mental structures” (Starr, 1992, p. 274). Official classification of societal members may function as disciplinary and control device having profound effects on people’s relation to specific objects, events, and bears on how individuals come to perceive of their personal biography, past and future (Hacking, 1992; Starr, 1992; Suchman, 1994). Exemplary are socio-spatial classifications according to which individuals and areas are identified based on people’s economic “worth” or “risk.” “Redlining” first deployed to identify areas and people deemed unprofitable or high risk in the mortgage loan business in the U.S.A. is an example (Kitchin, et al., 2011).

Socio-spatial “categories differ from the classifications of the natural world in an undeniable respect. Classifications of the natural world are indicative of a one-way relationship in the sense that only people categorize plants: the plants are in no position to protest. People, however, have their own ideas about group membership...When institutions classify, therefore, they often confront the self-conceptions of the subjects” (Starr, 1992, p. 269). People, in contrast to the natural world, behave strategically when confronted with classification, because they care about the influence of classifications on their lives. “Trivial enough: only people can understand what they are called and

how they are described, so only people can react to being named and sorted” (Hacking, 1992, p. 190).

The connection between vernacular knowledge and the local society, on one hand, versus the connection between standardized, permanent knowledge promoted through legibility making by the state apparatus in Scott’s framework dissipates upon closer empirical inspection. The analytical poles (admittedly exaggerated a bit) drawn by Scott (1998) dissolve empirically in two main ways. First, the assignments of vernacular knowledge to the non-state, local realm and of standardized knowledge to the state can be switched. Second, the non-state/ state boundary is blurred with both the state and society being incoherent. This latter observation produces doubts about where to locate resistances to projects of standardization and simplification, and questions as to the agents who may adjust vernacular and standardized knowledge along a continuum between non-state and state members and interests.

Regarding the first point, the techniques and characteristics of knowledge ascribed to the state by Scott (1998) may also be employed by non-state actors. For instance, the power of maps as instruments of legibility making is being appropriated by non-state actors alongside other techniques, such as enumerations (Kitchin & Dodge, 2011). In the case of urban poor groups in Mumbai, Appadurai (2001) interpreted the self-survey practices of non-state alliances as a form of counter-governmentality. Self-surveys and participatory enumeration by residents of slums and informal settlements, sometimes with the support of technical experts and non-governmental organizations, have received increasing attention in recent research (Patel, Baptist, & D’Cruz, 2012). These enumeration practices may serve as a counter-force to evictions, promote mobilization and organization across geographical settings, and help putting residents’ concerns on the agenda of the state (Archer, Luansang, & Boonmahathanakorn, 2012; Arputham, 2012; Farouk & Owusu, 2012; Makau, Dobson, & Samia, 2012; Muller & Mbang, 2012). These studies furthermore demonstrate the cooperation between residents, non-governmental organizations, and state actors in conducting the surveys, for instance to support state-initiated slum upgrading schemes when residents fear surveys conducted by state officials alone (Baptist & Bolnick, 2012; Chitekwe-Biti, Mudimu, Nyama, & Jera, 2012). In sum, the techniques typical of state-driven legibility making, such as cadastral mapping and censuses, can be deployed by different agents. The characteristics of “official knowledge” may also apply to knowledge produced by non-state actors, may be produced by non-state actors together with state actors, and may entail a translation of vernacular knowledge of residents into the standard, unambiguous tables that are favored by state officials.

Conversely, the state may not at all pursue the legibility project, but rather have a strategic interest in ambiguous and changing knowledge. Several researchers have noted a conspicuous absence of comprehensive maps and planning documents in their studies of administration in South Asia (Ghertner, 2010; Roy, 2003; Hull, 2012). Roy (2003) contemplated whether it was a methodical or access problem in her ethnographic work in Calcutta until she came to the conclusion that comprehensive maps apparently did not exist in the city's planning and development departments. Roy (2003, 2009) argues that urban governance often functions by "unmapping" cities. The absence of maps and statistics allows the state considerable flexibility to alter land use, deploy eminent domain to acquire land, and move the poor around (Roy, 2009). Ghertner (2010) shows that aesthetic criteria override the evidence from statistics and numbers in recent slum resettlement policies in New Delhi with the "*appearance of filth or unruliness in and of itself ...[as] a legitimate basis for demolishing slums*" (p. 201, emphasis in original).

Providing a perspective from the western hemisphere, Nujten (2004) draws on ethnographic research on interactions between administration and farmers in Mexico, and concludes that "notions of governmentality based on institutional techniques are of limited value for the analysis of discipline and rule in Mexico [where] we do not find standard procedures but a bewildering world of labyrinthine offices and infinite administrative measures [and] we do not find the impersonal treatment of the 'clients' of the system" (p. 226).

At this point it is important to emphasize that slum listing and GIS property mapping are conceptualized as legibility making in terms of the requirements that underlie each in relation to their respective government improvement schemes. The question is precisely how and in how far, legibility and standardized, permanent knowledge is achieved or not in practice. During interpretations to answer research question three (and to an extent already during interpretations for questions one and two) an important theme emerged concerning the nature of the state, or rather the question about, who is a member of the state, and what are the state's interests?

I found the same questions addressed in anthropologies of the state literature, which amplify Scott's (1998) analytical framework by zooming into the relations between the local and the state. Scott's analytical scheme entails a specific notion of the state, namely the state as an outsider to and hovering above the local. In this sense, Scott's state is akin to Ingold's (2007) colonizers who produce lines of networks to chart out a new territory or Jance Jacob's (2003 reprint) urban planner who measures a "slum" via number tables rather than visiting the what Jacobs narrates as a vibrant urban neighborhood or to Latour's (1987, 1990) centers of calculation accumulating and morphing representations from and about distant places.

The state comes across as something distant from the local in Scott's (1998, 2012) work despite its direct impact on the local through the legibility project.

More recently this state-versus (local) society dichotomy has come under closer scrutiny. Far from being a monolithic entity with one coherent interest, the state consists of a multiplicity of agencies with partially overlapping jurisdictions, with complex and emerging relations to private and research entities, and is increasingly tied into international bodies and regulations and with multiple interests; the citizenry or "non-state" is just as incoherent (Fenster, 2006; Li, 2005).

The concept of governance as it emerged during the 1990s recognizes that rules and conditions for ordered action are not only set by the government, but include multiple institutions and actors involved in the process of governance, also those outside of government (Kooiman, 2003; Madon, 2009; Stoker, 1998). Governance as process also recognizes that government draws on a variety of tools and techniques to steer and guide (Stoker, 1998).

For the governance of government improvement schemes, if you will, recent research in anthropology has shown that the state is not the sole driver of improvement schemes. According to Li (2005), multiple authorities are involved in improvement schemes, including scientists, political activists, and ethnographers creating different assemblages of interests, techniques, and discourses intertwined with the state. But in addition to this multiplicity, the idea of a state as monolithic entity with one intent and as container of power is also contested (Li, 2005). Nujten (2004), based on ethnographic research in rural Mexico, argues it is "conspiracy theories, fantasies and desire around the 'hidden master' which obscure what are in reality much more de-centered practices of power" (p. 228). Drawing on ideas from Taussig (1992, p. 112) she ponders whether it is not the fantasies of the ejidatarios [members of peasant community] concerning the powerful centre that lead to 'the cultural constitution of the modern State - with a big S?' " (p.223). Gupta's (2006) ethnographic research of relations between rural people and state officials in a north Indian village demonstrates how decentralized and dispersed the state is empirically, and how it is implicated in the texture of everyday life raising similar concerns about the coherence and "monolithicism" of the state.

Similarly, Ferguson & Gupta (2002) argue that the idea of a state hovering above grassroots organizations does not hold empirically. The state viewed as set of practices is also very much local in terms of its materiality and situatedness. So called "grassroots" organizations may be global when they

network across continents and countries, for instance through international slum dweller associations. The idea of the state imagined in a vertical arrangement above the local and below the global, dissipates upon closer empirical observation. Rather, the game board is made up of multiple fields of power emerging from players' various tactics and practices (Li, 2005). This means that resistance to an improvement scheme does not need to arise from "pristine spaces outside of power," i.e. outside of the state, as Scott's (1998) work may imply, but can arise from within the bureaucratic apparatus itself (Li, 2005).

If the state does not hover above a multitude of local complexities endowed with vernacular knowledge, it is necessary to unpack the complexities through an engagement with state improvement schemes that encompass a range of tactics and techniques (Li, 2005).

The latter may involve different practices of legibility making, with different actors and interests involved, and with various effects on improvement scheme implementation and goals. In these practices, vernacular knowledge need not be deleted or ignored, but may be pulled into the production of official knowledge. Scott himself (1998) proposes the concept of *metis* as a practice by which forms of knowledge embedded in local experience are compared with the more general, abstract knowledge deployed by the state and its technical agencies. What is essential to *metis* is knowing, how and when to apply the rules of thumb in a concrete situation. We are now reminded of the work done by nurses in Meum et al.'s study (2011), who adjust standard and more static classification systems to local knowledge and situated categories. In the context of government improvement schemes and related legibility making the question then is, who within government or outside (or both) is translating between the locally specific category or vernacular knowledge, on one hand, and a larger scale standardized, more static system of classification. In Scott (1998) practicing and experiencing *metis* is almost always local – that is part of non-state realm – although it draws on and feeds back into general rules and concepts as they are applied to and adjusted in a given situation.

However, legibility making involves institutional classification, and this warrants a closer look at actors and interests that inhabit the spaces between state and non-state. Institutional classification involves two processes as Sokal points out (in Starr, 1992, p. 269). One, already mentioned, is the process of putting objects into groups or sets on the basis of their relationships and characteristics. The second involves the assignment of objects to groups in an already established classification system. The latter is often done by intermediary agents, for instance street level administrators filling out Census survey forms while interacting with residents. In state

improvement schemes these intermediary agents are conceptually comparable to Bowker & Star's (2000) or Meum et al.'s nurses (2011) filling tables of patient records while interacting with patients. As local categories and ways of knowing inform standard classifications and vice-versa, a looping effect is created that brings about classifications that are constantly emerging, fading out, and morphing. Classification in bureaucracy may press for formal classification and also involves, as other classifying practices, prototyping and more tacit choices in the grouping of people and items, but in addition it is constantly influenced by political alliances, coalitions, and movements (Starr, 1992) that cross the analytical state and non-state boundary.

A review of Timmer's study (2010) may serve as a summary and illustration for both amplifications to Scott's (1998) framework discussed on the previous pages. In his research of labor and land tenure arrangements of Bugi migrants in East Kalimantan Timmer finds that non-state actors emulate aspects of the state's legal culture and legibility making. This in turn transforms the property ownership regime of the region and allows migrants to create a new realm of participation, rights and citizenship. Furthermore, drawing on Ferguson & Gupta's (2002) work, Timmer's study problematizes the idea of the state's "vertical encompassment." Indeed, when apprehended empirically and ethnographically the state itself may look a lot like "civil society" (Ferguson & Gupta, 2002). In Timmer's study this becomes most visible in the ambivalent role of village and neighborhood heads, who at one and the same time represent the community as well as the state at its lowest level of jurisdiction. This is "the level at which the blurring of the state and non-state is truly personified" (2010, p. 710)."

The reason for an engagement with varied techniques of knowledge production is to explore what effects these tactics and techniques have on scheme implementation (Li, 2005). In his recent ethnography, Hull (2012) has explored these tactics and techniques in great detail capturing the interplay between state and colonial projects of legibility, on one hand, and its subversion and dissipation in the practices of urban governance. Hull's study combines insights from Science and Technology Studies (STS) and anthropology in an ethnographic account of bureaucratic practices in the planning and governance in urban Pakistan. His study of graphic artifacts and their circulation through the city of Islamabad illuminates how bureaucratic writing is not only a mechanism of state control over people, places, processes, and things, but that official knowledge production engages places and urbanites in such a way that the political function of documents is highly ambiguous. The documents, lists, and maps take on an agency of their own mediating between government and society. Although a state plan may be designed to separate the work of government from the larger social world,

individual documents and files work “not only as instruments of bureaucratic control but also as media of dissent and negotiation between the government and populace” (p. 66). According to Hull (2012), scholars need to explore the practices that enact bureaucratic objects, such as lists, petition letters, maps, and planning documents in order to discover how they have been turned into allies of individuals or groups of people that cut across the state/non-state dichotomy. This is necessary also to “explain the ordinary success of bureaucratic schemes” (p. 207).

In light of these recent anthropological insights, Li (2005) proposes to focus on three junctures in order to amplify Scott’s (1998) analytical scheme, namely (i) when local knowledge is adjusted for the purpose of the intervention, (ii) when local knowledge sustains bureaucratic and profit-making schemes, and (iii) when local knowledge and practice is embraced by experts (Li, 2005).

Research question three (How do SDI-based versus non-SDI based practices of legibility making work out in reaching the aims of their respective government improvement schemes?) in section 4.3 addresses the first two junctures proposed by Li. Although scheme implementation in the empirical cases both carry in their design the requirement that the state makes its society legible through official knowledge production, section 4.3 elaborates on how legibility making takes place in practice and in how far this varies between the two schemes. Zooming into the “pattern of relations,” which Scott himself mentions (1998, p. 24), legibility making in section 4.3 is conceptualized as the practices of knowledge production within improvement schemes that *arise along a continuum* between state and non-state actors, and between official and vernacular knowledge, between informal, situated and formal, standard category. This amplification allows bringing to the foreground legibility making practices that create varying entities with authority, practices that position people as members of certain groups and allows to explore practices that fill the gaps between official plans and on-the-ground realities (Li, 2005).

The interpretive moves elaborated on in section three are summarized in table 3.3.1 together with the research aims, questions and specific conceptualization used for analysis in the publications under part II of the thesis.

Table 3.3.1: Overview of the study's interpretive process described in sections one to three and thesis sections in part II of the thesis pertaining to each research question.

Research aims in relation to adopted research perspective (section 1.3)	Research questions	Main conceptual lens for interpretation	Sections in thesis
(Identification of research perspective and directions)	(Question that guided coding of literature: How are people conceptualized in SDI literature?)	(Open coding of literature adapting Orlikowsky & Iacono's (2001) literature classification & use of initial fieldwork material to specify and illustrate proposed research directions)	4.0
Explore the development of SDI as sociotechnical network at local and state-level across projects and time and identify problems encountered	1. How does SDI development take place in the case of digital urban property database development and what are the problems encountered?	Ribes & Finholt's (2009) "long now of infrastructuring" (Theory section 3.1)	4.1 & 5.1
Explore the outside of the SDI network, that is the actors and rationales involved in non-SDI based practices of information construction and exchange	2. What characterizes classifying practices in the case of slum declaration and in how far do these match the core tenets of SDI or not?	Mol & Law's (2002) classificatory and non-classificatory lists (Theory section 3.2)	4.2 & 5.1
Compare SDI and non-SDI based practices to explore in how far they each support implementation and aims of government improvement schemes	3. How do SDI-based versus non-SDI based practices of legibility making work out in reaching the aims of their respective government improvement schemes?	Scott's (1998) concept of legibility making amplified with reference to anthropology of the state literature (Theory section 3.3)	4.3 & 5.1
Discuss possible implications of SDI development in urban governance (based on the comparison between SDI-based and non-SDI based practices)	4. What are possible implications of SDI development in urban governance, especially with respect to the role of the state and citizen participation?	(5.1 synthesis of sections 4.1 to 4.3)	5.2

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PART II: Publications

4.0 Conceptualizing people in SDI literature: Implications for SDI research and development*

Abstract

People have always played an important role in SDI research. SDI researchers discuss in their papers the role of people explicitly or refer to people implicitly and from different angles. For example, they view people as users of SDI, as evaluators, as learners of SDI, as champions driving development, among others. In this article, we conduct an interpretive analysis of 142 peer-reviewed articles on SDI research from 1999 to 2010 and classify these on the basis of how SDI researchers view people. We discuss the implications of each view on people for SDI research and development. Our classification of the literature reveals that our field does not yet engage deeply in the everyday work of people as practitioners: planners, policy makers, and administrators. Compared to other views, a view on people as practitioners focuses on the relations not only between people, technology and data, but also their relations to things like land and urban space. It also emphasizes historical contingencies. This makes the 'people as practitioners' view especially relevant for contexts where SDI is only recently emerging and necessitates a dialogue with other spatial disciplines like planning and geography. Drawing on literature outside of mainstream SDI we outline two future research directions for a 'people as practitioners' view.

Keywords: SDI research, literature, people, practice, institutionalizing, planning, India

* This section is based on (sections and figure/table numbers adjusted to thesis structure): Richter, C., G. Miscione, & Y. Georgiadou (2010). Conceptualizing people in SDI literature: Implications for SDI research and development. *International Journal of Spatial Data Infrastructures Research*, 5, 286-325. Doi: 10.2902/1725-0463.2010.05.art12. The work is licensed under the Creative Commons Attribution-Noncommercial Works 3.0 License.

4.0.1 Introduction

SDI researchers often acknowledge that people are at least as important in SDI development as technological innovation and solutions. The nature of SDI according to Williamson et al (2003) is dynamic; and partnerships, social systems, and stakeholders' different views influence the nature and characteristics of SDI, while people are the "key to transaction processing and decision-making" (p. 26). In National Spatial Data Infrastructure (NSDI) documents from North America, Africa, and Europe analyzed by Homburg and Georgiadou (2009) people are mentioned in their roles as data custodians and beneficiaries, as components of SDI, and in terms of their spatial or information technology skills, awareness, and capacity. Since its inception in the 1990s, the term SDI entails not only spatial technology, policy and data, but also the role played by people in SDI development.

In this paper we ask how people have been viewed in SDI literature in the past ten years. How do authors of SDI research articles perceive people, their role in SDI, their relation to technology and geographic data in their research and texts? Different views on people have implications for research and development of SDI, a claim that we substantiate later in this study.

We coded 142 articles from major Geographic Information Science (GIScience) and SDI journals as well as peer-reviewed conference proceedings and edited books in terms of how authors view people in SDI research. Our paper is inspired by Orlikowsky and Iacono's (2001) analysis of articles published in Information Systems Research over a ten years period. Orlikowsky and Iacono used a grounded theory approach to inductively derive authors' views of information technology (IT). They derived 14 conceptualizations, which they then grouped into five clusters based on commonalities and differences. Their main finding was that overall the IT artifact, which is central to information systems research, had been under theorized in the literature. Orlikowsky and Iacono ended up "desperately seeking the 'IT' in IT research," and proposed a direction "that begins to take [IT] as seriously as its effects, context, and capabilities [and] to theorize specifically about [IT] artefacts" (p. 121).

We follow a grounded theory approach to analyze SDI authors' views on people. We derive 11 classes of how people are viewed, which we group under four meta-classes. However, our analysis departs from Orlikowsky's and Iacono's in two ways. First, people are not missing in SDI literature. However, they are also not often *explicitly* conceptualized. Our task is then to distill the authors' *implicit* views and understandings of people. The names we have assigned to each view in our classification and to each meta-class are "virgin labels." They do not link our classification to existing theories or disciplines. Second, our analysis of SDI literature leads to a different

conclusion. For each meta-class we identify its implications for SDI development and research. Mainly we find a gap in research that addresses people as practitioners striving to accomplish objectives and rationales that are not related to explicit SDI development initiatives and efforts. What do people do as urban planners and administrators? What are their day-to-day practices, but also what are their historical relations to land and urban space?

A view on people as practitioners entails a slight shift in research perspective. People and things (including data and technology) move to the background, while the relations between people and things in specific fields of practice move to the foreground, and serve as observation points for the study of SDI. Compared to other views on people in SDI research, the “people as practitioners and SDI makers in potential” is especially relevant when exploring SDI development in contexts where it is only recently emerging.

The paper is structured as follows. First, we present the methodology and classification of views on people in SDI literature. Second, we derive implications for research and development for each meta-class in terms of opportunities and risks and elaborate on the already mentioned gap in research (represented by the smallest number of articles in the classification). Third, we suggest two concrete future directions for a “people as practitioner” view in SDI research and development. Throughout, we draw on examples from outside mainstream SDI literature and from own empirical research.

4.0.2 Classification of views on people in SDI literature

We selected articles in the following manner: We searched titles and abstracts for a limited set of terms (“spatial data infrastructure,” “SDI,” “spatial data sharing,” “geospatial data infrastructure”) in two geographic information journals—IJGIS and URISA²⁶ for the years 1999 to 2010. Search methods and terms varied slightly depending on the search mechanisms of a journal’s database. We included all issues in IJSDIR, also those currently under review (these are the only non-peer-reviewed articles included), because they may represent the latest directions in SDI research. In the hope of capturing empirical research in the North as well as in the South, we also included two special issues of the journal *Information Technology for Development (ITD)* on SDI, two peer-reviewed GSDI conference proceedings (Onsrud 2007; van Loenen, Besemer, and Zevenbergen 2009) as well as Cropvoets et al’s (2008) edited book on SDI assessment research. The search yielded a total of 158 articles.

²⁶ IJGIS: International Journal of Geographic Information Science, IJSDIR: International Journal of Spatial Data Infrastructure Research, URISA: Journal of the Urban and Regional Information Systems Association, ITD: Information Technology for Development Journal

Sixteen articles were excluded from analysis, because they are either forewords, introductions, and editorials and hence not peer-reviewed; or they are meta-literature, including literature reviews, reviews of theoretical frameworks and their respective implications, one article on statistical modeling (Propastin et al, 2008²⁷) and a synthesis of various evaluation frameworks (Grus et al's multi-view assessment framework, 2007, 2008). The individual evaluation frameworks are included in the analysis already.

The remaining 142 articles are quite heterogeneous in type and style. They include reports on national and regional SDI developments, commentaries and project updates, quantitative and qualitative empirical research, and position papers. Views on people tend to be more explicit when authors use specific theoretical frameworks. They tend to be more implicit in descriptive summaries and reports on national development efforts. In the majority of articles people are not mentioned directly, while in SDI evaluation frameworks, they may appear under a label (e.g. "human factor") or may directly be referred to as "people." Based on our coding we identified 11 views of people. These we aggregated into four meta-classes. In the following discussion of each meta-class and individual views we do not quote from all 142 articles, but only from the most representative ones.

4.0.2.1 People as makers of SDI

As makers of SDI, people drive SDI through their actions and behavior, and in some cases individual personalities. People share geographic data, develop metadata standards, and formulate policies and monitoring criteria for SDI development. How they do this is influenced by the organizational environment, other people, or their own personality. These people are either involved in formal SDI initiatives or their activities are considered to be relevant to SDI by the researchers.

There are four views in this meta-class: people as narrators, people as drivers, people as evaluators, and people as human sensors. Given that people in this literature stand out in their role as makers of SDI it is hardly surprising that the four views emerging from coding reflect different activities of "making" SDI.

People as narrators

Influential people write and speak about SDI thus influencing the perceptions of others, shaping the course of development, and setting agendas.

In this view the importance of discourse and language in shaping the evolution of systems and initiatives is emphasized.

²⁷ Study of scale-dependency in the relationship between rainfall and vegetation data

People are much like speakers who bring certain perspectives to an audience. The perspectives are woven in the speech, texts, and choice of metaphors, and shape participants' views and involvement in the subject matter. Metaphors used in influential documents reflect, but also guide the course of implementation as Puri et al (2007) and Georgiadou et al (2005) have shown for the Indian NSDI case. People's objectives and values become encapsulated in the very words and terms they use to describe a new technology or its envisioned benefits and evolution (Harvey, 2009; Koerten, 2008). People guide and shape the development of SDI through discourse in this view.

People as drivers

People drive SDI by sharing data, coordinating with each other in meetings, committees, or through virtual networking. They work as partners in initiatives that cross departmental, formal organizational, geographical, and disciplinary boundaries. Such implementation efforts require a great deal of improvisation, but also strategy and vision (Lance and Bassolé, 2006).

Some people are especially effective drivers of cross-boundary initiatives. Craig (2005) calls them the "White Knights of Spatial Data Infrastructure" the individuals who exhibit certain characteristics that allow them to foster and promote SDI, including idealism, enlightened self-interest, and involvement in a professional culture.

In sharing geographic information, people drive SDI whether sharing is digital or not, formal or informal. People's motivation and willingness to share data, but also their social norms and values (e.g. Nedovic-Budic et al 2004; Wehn de Montalvo, 2003) and people's positions in organizational hierarchies influence if and how people share data. Data sharing is embedded in other activities and is also based on interpersonal trust (Harvey and Tulloch, 2006). People in this view drive SDI on an almost daily basis through their personalities and activities.

People as evaluators

People involved in SDI development efforts prepare reports and cost-benefit analyses in response to public administration funding requirements (Lance, 2008), or for donor agencies. As members of monitoring committees, people engage with the task of selecting appropriate criteria for evaluating spatial data policy and implementation (Vandenbroucke, 2008). Criteria for evaluation of the geographic information itself are *made* by people based on their values and perceptions (de Vries and Miscione, 2010). People design methods to evaluate SDI efforts and demonstrate accountability. In this view people reinforce SDI by evaluating it.

People as sensors

The central notion behind people as sensors is the potential or actual contribution people make when they perceive the world around them and pass this information on to others quickly, digitally, and across potentially large geographic distances. A central question is to what extent can the user of the information trust the human sensor? With a remote sensing device one can partially rely on its set technical parameters to measure and evaluate data accuracy and quality. In comparison, the interpretation of human sensor information lacks a "technical baseline." Here characteristics and background of people, such as their knowledge of place and their reasons for providing the information, may influence the (perceived) quality of such voluntary geographic information (e.g. Goodchild, 2007). The boundary between users and producers becomes increasingly blurred in the Web 2.0 environment (Coleman et al, 2009). Further, people may not provide information willingly or knowingly, but they function as human sensors when this information is more or less automatically transmitted, compiled and used by someone else as in the case of digital footprints, where people provide information as they go about living – as tourists, as visitors at events (Girardin et al, 2009), mobile phone users, or when they log in to websites.

4.0.2.2. People as adapters of SDI

People as adapters do not only adopt SDI related technology. Like musicians who adapt a composition for particular voices or instruments, people adapt technology and tailor innovations and methods to their needs and applications. New sociotechnical networks may form and grow through cycles of adaptation. In turn, people learn and perceive differently of sociotechnical change as well as its outcomes.

People in this view form groups, but not pre-defined along formal organizational boundaries or based on theoretical relations to geographic data (e.g. provider versus user). Instead, different groups of people form varying alliances with technology. Through time these alliances form through people's learning and adaptive powers. But groups also emerge based on differences in people's perceptions of sociotechnical change and by being impacted differently.

There are two views in the adapter meta-class: people as learners and people as perceivers. Both directly or indirectly shape the development of SDI, but the learner view assigns a more active role to people in the course of sociotechnical change. In the second view, people perceive of and are impacted by technological change. They appear more as passive respondents to or recipients of change.

People as learners

People influence the trajectory of sociotechnical development through their ability and nature to learn from and with technology. They learn new software, learn of other people using new methods or employing new types of information and software. Over time people create alliances with technology and each other around technological development efforts. This in turn shapes people's knowledge of the technology and its opportunities (Davis and Fonseca, 2006).

Camara et al (2006) provide an account of how technology diffuses through people as they begin to employ and adapt to it, thus growing into a socio-technical network. The trajectories of such processes of learning and adapting can be various. How fast people learn a new software depends on its ease of use and on people's existing knowledge and skills. But it also depends on the trust that people put into a technology and into its advocates. The trajectory of socio- technical change is shaped by people's different perceptions of the technology and their conversations, perhaps misunderstandings about technology (Moreno- Sanchez, 2007).

Depending on a social group's technological frames people's perception of the technology varies and in turn may impact developmental efforts (Puri, 2006). People then also evaluate efforts differently through time as learning and adaptation continue (Bregt et al, 2008).

People as perceivers

If the emphasis lies on people's perceptions of and reactions to the outcomes of sociotechnical change, they are viewed more directly as perceivers and have a rather passive role in shaping sociotechnical development.

People are impacted by changes in sociotechnical arrangements and benefits and shortfalls of such changes are perceived differently. Opinions about the effectiveness of inter-organizational GIS development vary between people depending on the area of benefit, such as communication and coordination versus improvements in decision processes, problem analysis, or public service (Nedović-Budić et al, 2008).

People may themselves be viewed as the outcome of SDI development. In a study measuring the wider societal impact of SDI, Craglia and Campagna (2010) find greater user involvement and willingness to cooperate amongst people involved in the development.

Technological changes are not neutral, but may marginalize and exclude people (Aanestad et al, 2007) or transform the role of people vis-à-vis the state (van Ooijen and Nouwt, 2009).

4.0.2.3 People as elements of SDI

People are viewed as elements of SDI, because they are aggregated into groups along with other constitutive elements of SDI. These elements include cooperation between organizations and government, social and technical factors, and geographic information (GI) flows. As groups, people may function as nodes in networks of cooperation and along GI value chains, or as factors in evaluation frameworks. Attributes and values are assigned to people not individually, but to abstract groups of people.

There are four views in this meta-class: people as users, as members, as indicators, and people as providers-users. People are explicitly or implicitly grouped depending on which aspect of SDI development is emphasized. In the user view the focus is on technological design, and people implicitly form one group of (potential) users – the human vis-à-vis technology. Inter-organizational cooperation and data sharing are emphasized in the people as members view, where people are viewed as members of formal organizations, state versus citizenry, or as members of administrative government levels. The people as indicators view explicitly groups people into indicators and factors vis-à-vis other factors in SDI, especially for evaluation and development frameworks. People as providers-users are grouped according to their role in flows of geographic information as providers and users, or as creators, processors, and managers of information.

People as users

In the user view, people are implicitly grouped as humans vis-à-vis the machine; and machines substitute part of human's behavior and certain tasks. Discussing the nature of cyber infrastructures Bowker et al (2010) use the example of e-mail security to illustrate, how people can distribute their trust between the social and technical. People can choose to rely on technical solutions, for example the installation of firewalls and passwords, or can choose to work more socially and ensure that members of a scientific community adhere to certain norms of data usage.

In the people as users view, the solutions presented are distributed towards the technical side. People are viewed as human users of tools. The tools in turn replace human tasks, behaviors and organizational processes.

Human notions of trust and security become transcribed into technology through digital license management (Bishr et al, 2007). Manigas et al's (2009) "metadata manager" should "help create, collect, and manage metadata at the appropriate levels of a Spatial Data Infrastructure" (p. 151). And people are the beneficiaries of technological design. They should be able to rely on these designs and tools to make work easier and faster.

When emphasis is on technical implementation of existing SDI standards and policies, people are also implicitly viewed as users within specific application domains, e.g. noise mapping (Czerwinsky et al, 2007) or river basin management (Zarzaga-Soria et al, 2007). A smaller number of articles relies on procedures and (theoretical) work flows within specific application domains. To address the needs of these specific domains researcher use procedures and workflows as basis to draw implications for design and information content of SDI (e.g. Akinyemi, 2007 for poverty mapping methods).

People as members

People are viewed as members of formal organizations, administrative levels, or as members of sectors, for example private versus public sector. Individually, people are not agents of SDI development, but only in so far as they are members of pre-defined socio-political entities. Authors describe and discuss the role of these organizations in SDI development and the importance of cooperation and coordination between them.

Technological development also plays a role in accounts of national or regional SDI development efforts, but the emphasis lies on cooperation between various formal organizations in the region and their role in SDI. People as individuals or their specific roles within organizations are absent in these reports. Also, interactions between individual people or between people and technology are of less concern. The focus lies on cooperation between government levels, private and public realm, or citizens and state.

Literature in other classes may also aggregate people on the basis of formal organizations, but in the people as members view discussed here aggregation takes place at a higher level. For example, McDougall et al (2007) study data sharing between state and local government based on the existence of "data sharing partnerships" between jurisdictions, not – as other studies in data sharing do – based on individual people's position within an organization or individual motivations to share data. Van Loenen and Rij (2008) propose a model of SDI development from an organizational perspective. The model consists of stages from "stand alone" to "network stages" corresponding to increasing levels of cooperation. Development depends on several attributes, which are not assigned to people as such, but to the organizational level. It is the organization or socio- political entity (citizen and state) which holds objectives and mandates, and participates in coordination and cooperation.

People as indicators

People are viewed as indicators of SDI performance or status, and as factors influencing the development of SDI on equal par with "non-human" factors. Authors acknowledge that SDI development includes not only technology and

data, but also people, networks, data access and sharing policies, legal issues of data rights, ownership, and privacy. Current approaches to SDI assessment seek to capture these many aspects as well as the dynamics of SDI development by identifying and applying increasingly elaborate sets of indicators. People are drawn into the calculation by assigning them attributes or measurable values, such as level of GI awareness, IT skills, and IT culture. These may take the form of indicators and factors, such as "human factors." In Delgado Fernández et al (2008), a country's readiness to undertake SDI depends on people as "human resources," which in turn can be measured based on human capital, SDI-culture, and individual leadership.

There is also a more implicit conceptualization of people contained in indicators like "cultural and political" and subsumed under factors such as "partnerships" (Steudler et al, 2008). People are viewed as components of SDI, where each component is assigned certain attributes, for example spatial literacy and thinking (Rajabifard, 2008).

The values assigned to a "people component" seek to account for people's relation to data and technology, such as SDI awareness, culture and willingness to share (Eelderink et al, 2008). Importantly, these are not values held or expressed by people, but numerical values assigned to indicators by the researcher or theorist developing and/or testing a framework.

In some (proposed) assessment frameworks people are nearly absent. In Toomanian's and Mansourian's (2009) analysis of strengths and weaknesses of business management models for SDI implementation, assumptions about people's needs and aspirations are implicitly reflected in indicators like team building, participation, and easy understanding.

People as providers-users

People are viewed in relation to geographic data flows as providers and users, suppliers and customers, or as nodes along data flows, each node adding value to geographic information. Research objectives include the measurement of spatial data clearinghouse use (Cromptvoets and Bregt, 2007, 2008), assessments of data access policy and frameworks (e.g. Janssen, 2008) or theoretical measurement of GI value (Genovese et al, 2009, 2010; Poplin, 2010; van Loenen and Zevenbergen, 2010).

Often people are grouped along theoretical or actual movements of data. Data starts with people, who are producers or suppliers of data. It moves through people, who as a group may add value to the data. And data ends in the hands of users who access and download, or customers, who buy data. In some cases this entails clustering of activities which deal explicitly with geographic information, for example data collection, processing, and management (Castelein et al, 2010).

4.0.2.4 People as SDI makers and adapters in potentia

People are newcomers to SDI or potential makers and adapters of SDI. They are managing and administering land, plan and design housing, and make environmental policy. People may or may not become makers and adapters of SDI. They are first and foremost practitioners in their different work contexts and disciplines. Under circumstances, in which SDI may be an emerging topic, and where policies and standards are just beginning to influence daily practices people are SDI adapters in potentia. They may emerge (or not) as adapters and makers of SDI within the current context of their work.

People as practitioners

People as practitioners are first and foremost people, who do their job as planners, administrators, private managers, grassroots activists, community organizers, and so forth. Authors viewing people as practitioners focus on the wider context of a specific practice, for example land administration and policy making.

The “people as practitioners” view de-emphasizes people in so far as the focus lies on what people do and how these practices arise from local history and geography. For the field of land administration in Poland, Harvey (2006) analyses the negotiations that take place between the requirements of a new digital cadastre system, on one hand, and the historically evolved flexible practices of land tenure, on the other.

In their day-to-day work people are immersed in relations not only to data and technology, but also to resources, such as land and water and the historical practices of managing or administering these resources (Silva, 2007).

People do not work according to mandates and official procedures only, but adjust day-to-day practices to achieve certain objectives, for example the provision of housing to urban neighborhoods. Problems to sharing data may “stem in large part from the unique socio-political positions, capacities, epistemologies of ... data users” as Elwood (2007) has demonstrated for grassroots NGOs. We have summarized our classification in table 4.0.1 from the largest to the smallest meta-class.

Table 4.0.1: Summary of implicit and explicit views on people SDI literature: classification and derived meta-classes

Our classification of views on people in SDI literature	Frequency	%	Frequency	%	Meta-Class
			91	64.1	People as elements of SDI
Users	34	23.9			
Members	20	14.1			
Indicators	16	11.3			
Providers-Users	21	14.8			
			30	21.1	People as makers of SDI
Narrators	3	2.1			
Drivers	16	11.3			
Evaluators	6	4.2			
Human sensors	5	3.5			
			17	12.0	People as adopters of SDI
Learners	10	7.0			
Perceivers	7	4.9			
			4	2.8	People as SDI makers/adapters in potentia
Practitioners	4	2.8			
Total	142	100.0	142	100.0	Total

4.0.3 Implications for SDI research and development

As mentioned, 16 of the 158 selected articles were excluded from analysis, because as editorials and forewords they are not peer-reviewed, or they are combinations of assessment frameworks, or theoretical and literature reviews. The percentages presented in tables 1 and 2 are based on the remaining total of 142 articles. Research implications for each meta-class are shown in table 4.0.2 again from the largest to the smallest meta-class. We will discuss implications for research in the same order.

In the largest meta-class people are viewed as elements of SDI (64.1%) and grouped either as users vis-à-vis technology, as members of socio-political entities, as indicators, or in relation to geographic data. In these views it is the aggregates of people, not individual people, who are expected to coordinate, share data, hold certain levels of IT capacity and skills. In some

cases, people are grouped along formal organizational boundaries as well as users and providers. Especially in the indicator class attributes are assigned to groups of people, the "human factor" or "people indicators." Such attributes are IT capacity and skills, SDI awareness, and so forth. The departing points for grouping people are notions of what SDI is made of, for example inter-organizational cooperation, human capacity, and information flows.

These frameworks provide a basis for initial comparisons at national and cross-national scale. Importantly, the frameworks and descriptions of initiatives allow a diversity of actors to gather around the concept of SDI while recognizing its multifaceted and complex nature. Reports of SDI development, conceptual frameworks for the evaluation of SDI and GI offer a blue print for formal organizations, government, citizens, and researchers to communicate about SDI as the number of initiatives around the world is growing. In sum, literature in which people are viewed as elements brings SDI to the table globally in an effort to reach agreements on approaches to design and evaluation. It also offers technical and methodological tools for specific purposes.

However, in this meta-class people are homogenous through time and space. SDI is assumed or expected to be a globally homogeneous outcome of linear processes. For example, coordination and data sharing between formal organizations, government levels or between state, citizens, and private sectors are conceived as indicative of SDI development stages. Based on a review of national SDI initiatives Rajabifard et al (2006) concludes that although "[t]hese examples show the different paths that can be followed in the creation of an SDI" (p. 733), they also "show, [that] the process of SDI development is continuously evolving with a continuum of development across all countries...Most countries are at some stage of the continuum" (p. 736).

In the attempt to offer blue prints for future development that are applicable as widely as possible, people become submerged into globally homogenous elements of SDI. Here we run the risk of over-simplifying the differences in people's influence. We fail to learn and account for, how and why people actually make SDI happen through their actions and also how SDI may be perceived of and enacted differently by people.

We find a large number of articles relying on conceptualizations of SDI according to a hierarchical nesting of administrative levels and organizations, or based on multi-criteria indexes, and linear information flows. One reason for this may be the translation of technical information system design models to the socio-technical world of SDI development. In technical design

modeling the logic underlying languages like Unified Modeling Language (UML) provide the necessary structures to translate the world into abstract relational databases and create levels of digital data interoperability and comparability. But a more or less direct transfer of such models to the study of the sociotechnical dynamics in information infrastructure is questionable, because it is difficult to assign globally applicable attributes and values to indicators, like "culture" or to "social factors." It is equally questionable and difficult to map out the nature and type of relationships between any one factor or component of SDI.

Although small compared to the first, the second largest meta-class comprises literature, in which people are viewed as makers of SDI (21.1%). People share geographic data, drive coordination between agencies, evaluate SDI efforts, create monitoring criteria and provide geographic information through Web 2.0 technology. People make SDI through such activities within the framework of formal organizations, mandates, and requirements, but people also actively engage as individuals and through discourse. Individual behavior and motivation, positions in an organization, personal characteristics, and day-to-day demands for evaluation influence how and why people make SDI. Of the four meta-classes this view emphasizes the influence of people as individuals the most with respect to SDI development. It de-emphasizes the influences exerted by and changes in technical artifacts, for example software or GI databases, more so than the adapters of SDI meta-class.

In the second largest meta-class people are also viewed as practitioners, but as such they are explicitly makers of SDI because their activities are linked to initiatives that are labeled "SDI initiatives" officially or by the researchers. First, activities relevant to making SDI are distilled, then people are studied in terms of how they go about these activities. This demonstrates the different ways, in which SDI is being developed through people's activities and also calls for alternative views on SDI, especially in recent VGI and Web 2.0 developments. But there is a risk here to separate SDI as a conglomerate of distinct sets of activities (design versus sharing versus evaluation) from the wider context of work and organization. In the majority of this literature there are missing links between people's activities explicitly related to SDI initiatives, on one hand, and on the other hand, people's rationales, intentions, and organizational structures and requirements, that are not explicitly related to SDI, but which influence the development of SDI. Furthermore, the activities involved in infrastructure development are not necessarily distinct steps from design to use to evaluation, but in reality they often mingle and overlap (Pipek and Wulf 2009).

The meta-class labeled “people as adapters of SDI” follows third with 12% of the articles. People react and respond differently to technology, learn from and adapt to technology. They may be more or less active respondents to SDI perceiving benefits differently. People’s adaption, inclusion or exclusion are also outcomes of sociotechnical change. This meta-class captures the changing nature of SDI in time and place. People’s varying perceptions of technology are not indicative of inconsistencies and failures in development, but are active shapers of the technology. This meta-class (especially the learners view) draws more or less explicitly on traditions and approaches from Science and Technology studies. This meta-class emphasizes the two-way shaping between technology and people through time. What SDI is or what it is supposed to be is viewed “through the eyes of different relevant social groups produc[ing] different descriptions— and thus different artifacts—this results in the researcher’s demonstrating the ‘interpretative flexibility’ of the artifact” (Bijker, 2010, p. 68).

People encounter, respond to and adapt to SDI differently; and this literature provides insights into how SDI as a sociotechnical arrangement evolves and with what consequences. From this view SDI is more open-ended, a sociotechnical arrangement enacted through the interplay between people and technology across various activities and organizations. This offers lessons and grounds for theory building for the scaling of SDI systems.

However, the majority of research in this meta-class does not explore alternative development paths at different points in time similar to Harvey and Chrisman’s (2004) study of the “elusive origins” and reversible paths of geographic information systems. Most of the research in this meta-class explains the success of one path, but sheds less light onto what alternatives existed at the beginning, and the technical and social actors, which were abandoned through time.

Because of this, we may overlook what happens outside of an evolving network or system. There is the risk of missing the link between the enrollment of people in new initiatives and their work and goals previously unrelated to SDI. How does enrollment in an evolving installed base affect people’s organizational patterns and work practices and with what consequences in terms of their respective objectives? Another risk lies in ignoring which actors do not become enrolled willingly or unwillingly. How and why are they affected vis-à-vis those involved in a growing network?

Table 4.0.2: Research implications for each meta-class: opportunities and risks

Meta-Class	%	Research Implications	Risks/Limitations
		Opportunities	Risks/Limitations
People as elements of SDI	64.1	Brings SDI to the table for various actors to gather around while acknowledging the complex and multi-faceted nature of SDI and allows for initial global comparisons Provides technical and methodological tools	Risk of neglecting differences between people in shaping SDI Implicit assumption of SDI as linear process ending in one model SDI with applicability in any context
People as makers of SDI	21.1	People's successes, failures, tensions offer lessons for SDI theory building and development	Risk of missing links between activities labeled as SDI and other activities and requirements
People as adapters of SDI	12.0	Successes and failures in scaling of SDI and effects/impacts offer lessons for SDI theory building and development	Risk of missing the actors not involved in evolving systems and networks and effects on meeting objectives for those enrolled and those not
People as SDI makers/adapters in potentia	2.8	Knowledge base for local SDI institutionalization and evaluations recognizing geographical and historical contingencies	Risk of missing "when" SDI is, that is to move from historical and place specific obstacles to theories of SDI evolution in different contexts

In the smallest meta-class (2.8 %) people are viewed as practitioners in the wider context of their work and in relation to objectives and things important in the work. Four articles constitute a distinct meta-class, because people are not viewed through the lens of SDI, but through the lens of their practices. Positioned at the local fronts of emerging SDI endeavors these SDI makers/adapters in potentia are converting paper based property management systems into digital cadastres or are cooperating with international consultants to develop and implement strategies for a digital land administration system. They do this as professionals as part of their jobs. They are planners, land administrators, advocates for the poor, environmental policy makers, and so forth. This research falls in line with Chrisman's (1987) call for geographic information system design to align with the agendas of data custodians, namely institutions that carry out mandates.

The search should not be for flows of data, but for the mandates that cause the flow (p. 1369).

But people do not work based on established procedures and methods alone. They work in more or less flexible relations to other people, to land and environment, and to political and administrative structures. In one sense practices are the day-to-day activities of people in their work. These can be very flexible and improvisational. But in another sense, practices are also institutionalized patterns; ways of doing things that are accountable and rooted in socio-historical developments. What matters in these practices are not only relations between people and technology, or people and data, but also between people and the things and objectives important in the wider context of work.

Through focus on people's practices, relations become important in this view, including those to land, water, urban space etc. In turn there is emphasis on historical contingencies of different contexts. The relation between people and land, for instance, evolves over long periods of time and bears on current land administration practices. It thus influences future change, for example new technology and system development.

The concern for historical contingencies makes the view of people as practitioners especially relevant to analyse the "emerging" fronts of SDI. These fronts are places, instances, and boundaries, where SDI as concept or as development initiative is relatively new. These may be instances, when national standardization requirements and guidelines reach local administration offices. They maybe the boundaries between those local actors enrolled in SDI initiatives and those not (yet) enrolled. They may also be boundaries between digital and paper technology. In either case, SDI's emerging front marks a boundary between historical contingency and future expectation.

None of the first three (quantitatively dominant) meta-classes is sufficient in itself to explore the negotiations that take place at the emerging fronts of SDI. The first meta-class assumes that negotiations along this front involve similar issues in different places (e.g. human IT capacity and skills). The second and third views rely on existing SDI narratives, initiatives and activities. Explanatory power derives from how people and technology shape each other through time. But how can the beginnings, the "elusive origins" (Harvey and Chrisman 2004) be explained?

A "people as SDI makers in potentia" view allows to explore these origins of SDI development. Building explanations and theory from such research can produce a valuable basis for practitioners engaged in SDI development at the

boundaries between the historically embedded practices and future sociotechnical change.

The risk of this view lies in “getting lost” in the local history of fields of practice and relations between people and space. Chrisman (1987) pointed towards this paradox for the case of user needs studies. On one hand, current practice serves as guide for design, but at the same time a new system is disruptive and seeks to bring about change. There is the risk for research in meta-class four of failing to explain the potentials for change over the longer term in order to generate theories of SDI evolution, which help to frame future development. An important question this research can answer, but also must answer to be relevant for SDI is “when” is SDI²⁸, that is how and why do practitioners become makers/adapters of SDI?

For the study of people as practitioners to define clearly, what constitutes the “emerging front.” Is it between different levels of government, between types of formal organizations, between the digital and non-digital, or between two different fields of practice, or a mix of these?

In the next section we point to two possible research directions for the study of people as practitioners.

4.0.4 Future research directions

In this final section we discuss future research directions for studies that explore the emerging front SDI. To illustrate these we draw on empirical research from land administration and planning systems that was not included in our analysis. One direction to practice leads through “data,” the other leads through “people.” Both reflect an explicit concern with the past (longer or shorter term) to explain current practice and to reflect this with future and recent expectations for spatial technology development. Both directions also emphasize a concern for the relations between people and space (as they are embedded in practice).

One direction draws on Science and Technology Studies’ approaches. It leads to the relations between people and space through the practices of spatial data production in various application domains. In “Biodiversity Datadiversity” Bowker (2000a) argues that the ordering of data across disciplines “lead[s] us very quickly, on the one hand, into deep historiographical questions and, on the other, to questions of communication patterns both between various scientific disciplines and between those disciplines and legal and political bodies” (p.677). This also means that we

²⁸ Star and Ruhleder (1996) propose to ask “when” instead of “what” is infrastructure in “Steps towards an Ecology of Infrastructure: Design and Access for Large Information Spaces” (pages 111-114).

can learn from past database construction to inform future technical design. Taking a look at the practices of spatial database construction does not stop at the point of current data entry and standard formatting. It also traces socio-spatial categories backwards to different rationales and objectives in the practices of various organizations. Such "database ethnographies" (Schuurman, 2005) in turn provide lessons for database design in SDI. Based on the study of land use databases and underlying planning practice Schuurman and Leczinsky (2006) propose metadata ontologies to incorporate contextual knowledge. They are also able to specify what kind of knowledge is required to accommodate planning practice.

Such research does not need to depart from a digital, standardized database. It may also explore the practices of producing heterogeneous (in form and content) spatial data across organizations involved in planning and development practice. In our own research in Indian cities we conduct what may be called a "data production ethnography," because no centralized digital database exists in local slum improvement planning. Instead, we analyze how the different forms of spatial data in the process of slum planning are produced and what function they serve. We find that spatial data is contested in content, is duplicated and its production dispersed across different social groups. Importantly, these characteristics of data production are a driving force in the urbanization of slums. These practices of data production bring groups of people labeled as "slum" into the city in legal, spatial, and social terms. Our research is ongoing, but we can draw first implications for the design of spatial data technology to support local planning practice. First, it needs to be accessible to different social groups who may have conflicting objectives. Second, it needs to allow different groups to produce (not only view and access) spatial data in an ongoing manner, for example through participatory GIS approaches (Elwood, 2006) or through online access to produce geographic data on the web, for example through Web 2.0 and VGI technologies. In the case of Web 2.0 technologies, however, the main concern for development does not rest on issues of data accuracy. The function of Web 2.0 technologies would rather be to help legitimize different social groups' claims to the city, for instance by allowing them to produce counter mappings online. We use the broader term "spatial data technologies" in this empirical case, because how we conceptualize SDI for development may change in response to lessons from practice. Davis et al (2009) also propose to go beyond the concept of SDI from the point of view of environmental policy making for the Amazon in order "to integrate science and communities in the effort of creating, enforcing, assessing, and revising environmental policies" (p. 157).

Another future research direction leads not into the production and construction of data(bases), but through people's roles. More specifically, it

brings a historical perspective to specific functions (or positions) of people in an organization or in a field of practice. For the case of Bhoomi, a digital land registration system in rural Karnataka in India, De' (2009) investigates the historical role of the village accountant. From this we learn, how and why the new system disadvantages lower and landless castes. This in turn provides lessons for up-scaling the system or future implementations in similar contexts.

Obviously one role or function does not exist in isolation, but opens the perspective onto relations to other people and functions in an organization or field of practice. De's longitudinal research of Bhoomi provides evidence that the system has curbed corruption related to the issuance of Rights, Tenancy, and Cultivation documents, but it "benefited the land-owning castes the most, as they were in the best position to use the easy availability of land records to obtain loans and also participate in land transactions. Dalit and lower castes work mainly as landless labor force and as tenant farmers in the state and they had marginal use of the Bhoomi system" (p. 46). To explain, why lower castes did not benefit much from the system, requires a knowledge of historical relations between the roles of people and their respective relations to land.

Star (1999, p.380) writes that the image of information infrastructure development becomes more complicated when one begins to "examine the situations of those who are not served by a particular infrastructure. ... For the person in a wheelchair, the stairs and doorjamb in front of a building are not seamless subtenders of use, but barriers." Evaluation of SDI development is similarly relative depending on whether we view it from the "wheelchair" or walking, from the perspective of a member of the land-owning caste or a Dalit. To identify "who is who" and their different perspectives on SDI requires an understanding also of historical roles and relations between people and space.

4.0.5 Limitations and concluding remarks

Our classification of the literature has two limitations. First, we exclude a large body of literature on technical design and implementation. However, views on people in these studies are at least partially taken into account through inclusion of IJSDIR articles, such as reviews on technical design and prototype development. Our intention was to privilege that part of SDI literature often labeled "socio-economic and legal aspects of SDI," and not the literature labeled "technical aspects of SDI." A second limitation is the heterogeneity in text sources. Orlikowsky and Iacono (2001) reviewed articles from a single information systems journal over a period of 10 years. We selected articles from a variety of sources in order to gain a broad perspective on the comparatively young SDI literature. Technical design

research may focus on the presentation of technical solutions developed in the course of research projects involving a plethora of agencies, or it may focus on the practice of design, where people as technicians are the subject of study. Reports of the status of national SDIs put more emphasis on organizations carrying certain mandates with respect to SDI policies and implementation, whereas empirical studies of data sharing between or within formal organizations might foreground individual characteristics of people. The view on people is therefore also related to research questions and methodology. While coding the literature, we took note of authors' research questions, methodology, and independent and dependent variables in order to assure some independence between views on people and these variables in our classification.

The smallest number of articles views people as practitioners doing their jobs, who are newcomers to the concept and implementation of SDI. Bringing this view to research is useful especially to explore the emerging fronts of SDI. Because the emerging front may also be one between discourse and practice, where documents and narratives of SDI influence practice and vice versa, there are opportunities also for research that combines the narrator, on one hand, and maker and practitioner views, on the other. Here it is important to keep future expectations for SDI in mind and to analyze the changes from "existing" to the "new" practices and relations in order to explain, how and why people become adapters of SDI.

A view on people as practitioners broadens the questions we ask, especially about the history of relations between people and space. This opens a window for dialogue with other disciplines. For example, it offers the opportunity for a deeper engagement with traditional "spatial disciplines," such as planning and geography. Since the early 20th century academics and planning professionals have discussed the value of planning, its objectives, and approaches (Campbell and Fainstein, 2003). Geographers have proposed different conceptualizations of space (for example Massey, 2005). This is not to say that SDI research has to reinvent the wheel. Rather the spatial disciplines have accumulated a rich body of empirical and theoretical insights into the varied histories of people-space relations, which SDI research can draw on.

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4.1 In-Tensions to Infrastructure – Developing Digital Property Databases in Urban Karnataka, India*

Abstract

Digital property databases are being developed across Indian cities. There are intentions to develop these into statewide information infrastructure. Recently the Delhi State Spatial Data Infrastructure was launched, which evolved from a property database. Because these efforts are recent little research exists on the problems involved and the consequences of the development. Through a lens of information infrastructure (II) theory my aim is to explore, how the effort is currently shaping up in the case of urban Karnataka. I find that in the II development tensions dominate, that are related to the concern of aligning end goals. These tensions are manifest in competition over short-term funding, individuals' interests with respect to computerisation, and problems of populating the databases through changing survey techniques. Survey techniques for property boundaries imply a stable and categorisable space aiming to provide a comprehensive snapshot of the city. This clashes with the flexibility in urban land and property regimes. While geospatial technologies are employed to eliminate flexibility, land and property regimes pose the major problem to implementation at the moment of digital recording. This implies that successful II development in the long-run may change current property and land ownership regimes with the potential of closing spaces of the city to some groups of people. It becomes a question also of whose interests, or what communities, are to be served by the II development.

Keywords

India, urban, property, land, tenure, survey, information infrastructure, GIS, geospatial technology

* This section is based on (sections and figure/table numbers adjusted to thesis structure): Richter, C. (2011). In-Tensions to Infrastructure – Developing Digital Property Databases in Urban Karnataka, India. *Environment and Urbanization ASIA*, 2(2), 505-222. Doi:10.1177/097542531100200205. Copyright 2011 National Institute of Urban Affairs (NIUA). SAGE Publications Los Angeles, London, New Delhi, Singapore, Washington DC. <http://eua.sagepub.com>.

4.1.1 Introduction

At the 2011 “Municipalika” conference on urban governance in Bangalore a full session was dedicated to the implementation of e-governance programs. The development of digital, specifically geospatial, databases for property registration featured prominently among the presentations and discussions. At the booths of all major municipalities in Karnataka the same reform priority was repeated: “We are now developing GIS [Geographic Information System] for urban property recording.” Across Indian cities the implementation of geospatial technologies like GIS in public administration promises a more efficient and transparent processes for land administration and property taxation and with it increased municipal revenue. We know little about, how these efforts are shaping up.

In India research on the development of digital land and property management has focused on rural areas, because historically the country’s political economy targeted agrarian issues (Durand-Lasserve and Royston, 2002) accompanied by rural computerisation efforts for land management and registration. These studies have shown mixed outcomes. The ‘Bhoomi’ project, a computerised land registration system in rural Karnataka, is often cited as a best practice case for digital land records maintenance and access, because corruption has decreased in some respects. At the same time researchers found negative effects of the project on marginalised and low caste rural population in terms of use rights to land and financial burden (Benjamin, S., Bhuvanewari, R., & Rajan, M. P, 2007; De’, 2009, Prakash and De’ 2007). On the other hand, Puri’s and Sahay’s (2004) study of GIS use for managing land degradation in rural Andhra Pradesh provides evidence of improved farmer participation, where GIS helped to make visible the inefficiencies of previous projects and led the administration to formally revive traditional water harvesting structures (605).

Varying research outcomes from rural India also reflect the dependency of success or failure of implementation on historical and geographic context. Given the diversity of Indian cities this highlights the importance for parallel studies in the urban arena. Madon and Sahay (2000) explore the potential of information technology (IT), especially GIS, for urban management and planning of mega-cities and call for “research at the conceptual level to understand the relationship between urbanisation, globalisation, and development management” (231). But there is virtually no research on how the recent efforts of developing digital property registration systems in cities have been shaping up during the past decade: what are the objectives, what problems are encountered, and what are the outcomes? Driven by aspirations to integrate and centralise databases, we witness the emergence of larger scale information infrastructures as in the case of the Delhi State Spatial Data Infrastructure (DSSDI), which evolved from an urban property GIS.

Information infrastructures are always to some degree irreversible (Hanseth, Monteiro, 1998). What becomes written into networked databases may stay for a long time impacting not only future infrastructure design and use, but potentially also the ways in which people can access, use, and claim land and property in urban areas.

This paper addresses this need for research through a study of what I call the "City Information Infrastructure (II)" in Karnataka. The City II consists of three partially linked efforts: the development of a municipal tax management information systems (tax MIS), of a state-wide property GIS, and the district level City Survey. Each of them can be explored individually, but there are efforts and future intentions to integrate these databases into one centralised data repository at state-level connected to individual municipalities via a network. City II can therefore be explored as a case of an emerging II, and I draw on Ribes and Finholt's (2009) framework for the study of tensions involved in the development of II. Specifically, I ask, how the tensions manifest themselves in the case of the City II. The aim is to analyse the problems involved in the development and to discuss the relation between City II development and urban property and land ownership regimes based on this analysis.

The paper is structured as follows. I explain the theoretical lens used for analysis, describe data collection and analysis methods, and present the empirical case as a chronological account. Then I present an analysis of the findings in terms of four dominant tensions. In the final section I discuss the reasons, why some tensions are more manifest than others and the implications of findings. Before turning to the theoretical lens, I give a brief account of the historical context in the following section.

4.1.2 Historical Context: Setting the stage for City II development

Computerisation started in the state of Karnataka in 1987 with the launch of computers in districts for routine processing applications (Madon and Sahay, 1996). The state has since gained a reputation for its advances in IT implementation in administration.

The current focus on property registration is in itself nothing new. Land tax has been the major source of revenue for all governments of India, including the British, especially after establishing direct rule in 1857 (Bannerjee and Iyer, 2005). The British set up various land tenure systems in different areas depending on the influence of individual administrators, political events, date of conquest, and presence or absence of a landlord class (Bannerjee and Iyer, 2005). Independence brought the formation of new state boundaries subsuming different areas and corresponding tenure regimes. Karnataka was

constituted after Independence from several regions, which had been governed under five customary regimes and within these counted up to 1500 forms of tenure (Benjamin, S., Bhuvanewari, R. , & Rajan, M. P, 2007). Litigations over land and evictions have been numerous in urban as well as rural areas (Morse, 1950).

According to Benjamin (2004) the “bulk of land in urban areas in Indian cities is ... in the form of [what he calls] ‘flexible settings’ ” (179) characterized by a loose regulatory environment oriented towards mixed land use, diversity of tenure claims and forms, and possibilities for incremental development within a wide range of infrastructure settings. The diversity of tenure regimes comes from various sources and events, including indigenous conventions, titles related to particular sections of legislation, announcements of particular national occasions, specific housing schemes, and titles handed down by local royalty (180).

In sum, development of the City II for land and property registration can be regarded as a continuation of past efforts and remains at the same time a formidable task considering the historically evolved complexity of land and property regimes in Indian cities. The current City II development is situated between these contingencies of the past and at the same time future aspirations to develop a larger scale infrastructure through integration of databases.

4.1.3 Theoretical Approach: Characteristics and tensions of information infrastructure

To sketch out characteristics of II I draw on different conceptualisations in the literature. These are by no means exhaustive, but they mostly inform the methodological approach to this study.

The first conceptualisation considers the multi-generational and emergent aspects of technological artefacts that arise as people (designers, developers, users, regulators, etc.) engage with them over time, across a variety of contexts, and has been advanced by Ciborra and associates (2000) and Hanseth and Lyytinen (1998, 2010) using the case of the internet. The view of II as sociotechnical networks is closely linked to the concept of the “installed base:” II “are never built in a green field, nor do they die – though they may ... rise to new forms” (Hanseth and Lyytinen, 2010, 4). New parts are integrated into an existing installed base through extension of the latter or replacement of existing parts. Besides enabling people’s work, this evolution also creates self-enforced path-dependency, where early design choices can change history by generating irreversible effects (Hanseth, Monteiro, 2010, 6-7). Sociotechnical networks always grow out of something and are (partially) irreversible.

Star and Ruhleder (1996) offer an alternative approach. They challenge the assumption that information infrastructure are “things” and de-emphasise technical artefacts and people. Their work is based on ethnographic studies of a collaborative system among dispersed geneticists, but is applicable to infrastructure in a broad sense. Star focuses on relations, as arguably the only thing that is knowable of II:

“For a railroad engineer, the rails are not infrastructure but topic. For the person in a wheelchair, the stairs and doorjamb in front of a building are not seamless subtenders of use, but barriers. [I]nfrastructure is a fundamentally relational concept, becoming real infrastructure in relation to organized practices.” (Star, 1999, 380).

What and how (information) infrastructure emerges is always related to what people are doing and their positions in relation to II. Hence, II includes as well as excludes people.

Finally, II can be conceptualized as large scale classification systems (Bowker and Star, 2000; Bowker, 2000a, 2000b; Bowker, et al, 2010). This approach draws on the case of the International Classification of Diseases and emphasizes the work of classifying and the development of standards. Such work is at once local and global. “Standards, categories, technologies, phenomenology are increasingly converging in large-scale information infrastructure” (Bowker and Star, 2000, 47). The study of the work which produces such classifications becomes important, because “large-scale classification systems are often invisible, erased by their naturalization into the routines of life. Conflict and multiplicity are often buried beneath layers of obscure representation” (Bowker and Star, 2000, 47). Moreover, this view emphasises the politics and histories that produce classifications and the potential of hardwiring these into digital databases producing “future ‘ripple effects’ throughout the complex web of relations that constitutes natural and social scientific activity” (Bowker, et al, 2010, 105).

In sum, II can be understood as sociotechnical networks that expand or sometimes shrink in time and space. They are relational with respect to people’s organisation, sunk into daily lives and work and often go unnoticed. II enables but also excludes people, and carries aspects of irreversibility, for example through inscription in classifications of databases and standards. These characteristics position the development of II in a field of tensions between the past, present and future. Pipek and Wulf (2009) refer to the development of II as “infrastructuring,” that is the “creative activity that can be described as design,” where design is understood “as any motivated, transformational activity that individuals or groups perform” (457). The lines between design, implementation, and use are blurred. Infrastructuring as

transformational activity means 'that it induces a change that is intended to have a longer-lasting effect' (457).

While the internet, for instance, has developed over decades, it is difficult to study IIs that are recently emerging, like the Karnataka City II. How can the work of "infrastructuring" be analytically explored in multiple settings considering the survey work on the ground, data entry in municipal offices, the intentions and activities of state-level administration, as well as rationales of national funding agencies more or less directly involved in II development?

Ribes and Finholt (2009) propose a methodological framework to study the long-term endeavour of developing II. The authors draw on the concept of the "long now," which is a "view of technology development that brings multiple concerns, and matters of organisation and technology, into the single frame of action that participants [in the development of II] encounter on a regular basis" (391). The framework is based on four cases of e-e-infrastructure development, which the authors use as a more generic term for information infrastructure (376). In each case participants are scientists from diverse disciplines and working in dispersed settings. Each e-infrastructure is to serve this multitude of scientific communities. The problems involved in the development are expressed as "tensions" by participants themselves. To characterise the "problem space" of II development the authors frame these tensions along two axes: *scales* and *concerns*. To explore temporal dimensions multiple *scales* of action are considered: the technical work of creating and deploying durable resources (enacting technology), the human work and organisational arrangements (organizing work), and the practical work of institutionalising through policies and reports (institutionalizing). At each scale Ribes and Finholt's interviews discovered a persistent set of *concerns* for long-term sustainability: ensuring that participants contribute (motivating contribution), coordinating among different scientific traditions and multiple goals (aligning end goals), and ensuring that resources are adopted by present as well as future users (designing for use). The interrelated tensions in the development of II are positioned in the space defined by the two dimensions, *scales* and *concerns*, as shown in table 4.1.1.

Table 4.1.1: Tensions identified by actors in long-term development of e-infrastructure, parsed according to persistent concerns and scales of action that participants of II engage in (Source: Ribes and Finholt, 2009, 380)

		SCALES OF ACTION		
		Institutionalising	Organising Work	Enacting Technology
C O N C E R N S	Aligning End Goals	Project vs. facility	Planned vs. emergent	Inclusion vs. readiness
	Motivating Contribution	Individual vs. community	Development vs. maintenance	Research vs. production quality systems
	Designing for Use	Communities vs. constituencies	Research vs. development	Today's requirements vs. tomorrow's users

I use examples from Ribes and Finholt's study to introduce and illustrate the meaning of each tension in the analysis findings section itself.

The Ribes and Finholt framework is useful for the City II case for two reasons. First, it is derived from tensions as they were expressed by participants in the development of II. Empirical data used for analysis of the City II is also from the point of those involved in II development at different administrative levels. Second, Ribes and Finholt develop the framework specifically for the study of recently emerging II, because "many of these projects are still in the early stages of planning development. Whether the resources and work necessary for permanent implementation and adoption will materialize remains unclear" (376).

4.1.4 Data Collection and Analysis Methods

I draw on data collected during 13 months of fieldwork (in four periods) in three cities in Karnataka: Bangalore, Mugdali and Dhabunagar. Because of more intimate and informal encounters in Mugdali and Dhabunagar and because I was asked by informants to keep anonymity, I have opted for fictitious city names in the cases of Mugdali and Dhabunagar.

Bangalore, the state's capital, and its region are sometimes referred to as the "Silicon Valley" of India, because of its high agglomeration of IT businesses. Both Mugdali and Dhabunagar are major cities in the state and have engaged in various e-government activities over the past ten years.

In Mugdali and Dhabunagar fieldwork was conducted through a multi-site ethnography (Hine, 2007). I spent extended periods of time in municipal offices and also followed bill collectors on their survey rounds. During these "visits" I conducted open interviews, but also observed and engaged in informal conversations. Data at district and state-level is based on semi-structured and open interviews. I also used one interview with a World Bank

representative and two DSSDI representatives from fieldwork in New Delhi. Sites for visits and interviewees were chosen during fieldwork. Starting in one place, for example the Mugdali IT office, I followed connections, which were made meaningful from that setting (Hine, 2000, 60) to other sites and interviews. For example, interviews at the Directorate of Municipal Administration (DMA) and Municipal Reforms Cell (MRC) at state-level in Bangalore became important, because municipal staff often send reports and data to these offices.

My research approach is interpretive: “what we call our data are really our own constructions of other people’s constructions of what they and their compatriots are up to” (Geertz, 1973 in Walsham, 2006, 320). Data used for analysis consists of field notes, photos, sketches, interview transcriptions, government documents, and online English language newspaper articles.

I initially followed Silverman’s (2005, 173) four ways to start data analysis and divided all empirical material by relevance into data directly related to the City II efforts, and other data related to survey work more generally, for example slum surveys.

Table 4.1.2 shows data sources used for analysis that is directly related to City II efforts by place and time period.

The first data source was used in conjunction with websites and newspaper articles to construct the chronological description of the empirical case. On one hand, this was a first step in data analysis to make sense of the process (Langley, 1999). On the other hand, the description provides the background to present findings. During the final reading of the empirical material I coded according to Ribes and Finholt’s nine tensions and wrote long descriptions for each. The findings are a condensed version of these longer descriptions. They exclude notes about tensions that did not manifest themselves in this empirical case, but will be referred to in the discussion section.

Table 4.1.2: Most important data used in analysis. During each period documents (powerpoint presentations, reports, guidelines, and frequently asked question sheets) were also collected. Repeated visits were more or less formal and involved observations and conversations in respective offices, taking photographs, collecting documents, and lasted on average between 20 minutes to two hours.

	Mugdali	Dhabunagar	Bangalore	New Delhi
August 2008	<ul style="list-style-type: none"> ▪ Extensive, open interview with GIS specialist and work demonstration ▪ Repeated visits at IT/statistics office ▪ Attended weekly urban renewal program project meetings 	<ul style="list-style-type: none"> ▪ Extensive, open interview with three MIS staff and two IT staff 		
Mar-Jun 2009	<ul style="list-style-type: none"> ▪ Shadowing of GIS property surveyors ▪ Repeated visits in GIS Department and IT/statistics office ▪ Interview with one zonal assistant officer and staff ▪ Attended weekly urban renewal program project meetings ▪ Interview and database demonstration at postal training centre 			
Sep-Dec 2009	<ul style="list-style-type: none"> ▪ Repeated visits in GIS department and IT/statistics office ▪ Interviews with two additional zonal assistant officers and staff 			
Oct 2010	<ul style="list-style-type: none"> ▪ Interviews in eight municipal departments plus IT/statistics and GIS offices about information system implementation and inter-municipal data flows ▪ Interview with Municipal Commissioner 			
Nov 2010		<ul style="list-style-type: none"> ▪ Interviews in 14 municipal departments about information system implementation and inter-municipal data flows , as well as MIS and IT offices ▪ Extended, open interview with GIS specialist ▪ Daily visits in MIS office and work 		

		<ul style="list-style-type: none"> ▪ demonstrations ▪ Interviews with Municipal and District Commissioners ▪ Interview with Survey Settlement and Land Records Department representative and field surveyors and work demonstrations (district level) ▪ Interview and work demonstration at citizen e-government centre 		
Dec 2010-Jan 2011			<ul style="list-style-type: none"> ▪ Interviews with DMA and MRC with formal presentation of the Karnataka Municipal Reforms Project activities ▪ Attendance of municipal conference, session on IT and GIS in municipal government ▪ Meeting with high ranking official of Revenue Department 	
Feb-Mar 2011				<ul style="list-style-type: none"> ▪ Interview with World Bank representative and interviews with two representatives of the Delhi State Spatial Data Infrastructure

4.1.5 Empirical Case: a chronological account of the City II

In 2004 the Commissioner of Dhabunagar Municipal Corporation implemented a set of administrative reforms. Several processes were computerised, including the collection of property tax (the "tax MIS"). To populate the tax MIS properties within the urban local body (ULB) boundary were surveyed via measuring tape recording dimensions of the building footprint. And data pertaining to building characteristics as required in tax by-laws, as well as owner information were collected. In the database each property is assigned a unique ID based on the municipal ward and a serial number. The location of the property is captured based on ward number and street name. The tax MIS went into use in 2005. Similar reforms were initiated in Mugdali and received major impetus when the Dhabunagar Commissioner, left Dhabunagar and took over in Mugdali in 2008.

In 2004, the Chief Minister of Karnataka gave his approval for the municipal reforms project Nirmala Nagara to be implemented through the MRC, which is working under the DMA in Bangalore. Nirmala Nagara was first funded by the Asian Development Bank (ADB) as part of an urban infrastructure project in northern Karnataka. In 2006 the World Bank (WB) took over funding. The program was expanded to include all municipal corporations and consists of five components aimed at computerising municipal functions: "Geographic Information System (GIS) based property tax system," accounting system, grievance system, birth and death certificate system, city website, public works system, water billing and trade licenses system. The applications and processes for this project were designed by the E-Government Foundation spearheaded by InfoSys, a private IT business. The "GIS-based property tax system" was later renamed to "Aasthi" ("property"). From here on I will refer to this component as the property GIS.

Around 2006 survey work for the property GIS started in Dhabunagar and Mugdali. The guidelines for surveying and numbering properties were prepared by the E-Government foundation and published as "A Guide to Street Naming & Property Numbering with Blockwise-FSN [field survey number] Concept" by the DMA. Important to this process is a uniform approach to property numbering across the state and capturing the location of properties spatially by digitizing block maps in a GIS environment with support from the Survey of India. The goal is to integrate this spatial data with the tax MIS. During repeated visits between 2008 and 2011 I found conflicting progress information on the property GIS, and municipal staff frequently expressed concerns about delays in surveying work.

In 2008 the Department of Land Resources initiated the National Land Records Modernization Programme (NLRMP). Presently, five cities are selected, including Mugdali and Dhabunagar. Ideally, properties and transactions are recorded in the NLRMP database first and used also by the ULB for purposes of tax calculation. Implementation of NLRMP began in Dhabunagar through the District level office of the Survey Settlement and Land Records Department (under state Revenue Department) in 2010 and is locally referred to as the "City Survey." I follow this nomenclature from here on. The City Survey covers both ULB area and an additional 'urban growth area' around the ULB. Field surveys are conducted via Global Position System readings (GPS) and Total Station Survey (TSS) to capture lanes and property corner points. Later this spatial data is to be merged with the so called non-spatial data, namely ownership information. For the latter various documents are collected and conflicting histories of land rights and ownership need to be resolved involving an inquiry officer.

The objective is to move from presumptive to conclusive titling, to protect buyers of land and prevent litigation through a standard reference system for land parcel boundaries, to categorize land according to ownership types (government versus private), and to identify "wasteland."

According to MRC officials, the long-term goal is to develop a central data repository at MRC for all urban local bodies, except Bangalore, to share property records data as well as additional data layers with other government agencies for urban planning and management in the state. Application development for Nirmala Nagara components is already being centralised in the MRC office. According to MRC, the decision on who will maintain "City Survey" data is pending in court. However, according to a state-level officer of the Revenue Department the mandate to regulate land tenure lies with the Revenue Department and accordingly data maintenance of land records should not be responsibility of the MRC.

Because of these long-term aspirations and already developed links between the three systems (tax MIS, property GIS, and City Survey) the whole case is referred to as the City II in the following sections and viewed as a case of II development.

4.1.6 Data Analysis Findings: Dominant tensions in the case of the City II

In the development of the City II four tensions are dominant: "project versus facility," "planned versus emergent," "inclusion versus readiness," and "individual versus community". The first three pertain to the common concern of aligning end goals in II development, whereas the fourth pertains to the concern of motivating contribution of participants. The other five of Ribes and Finholt's tensions do not manifest themselves in the City II. The findings are summarised in table 4.1.3. In the following I will only describe the manifest tensions.

Table 4.1.3: Ribes and Finholt's Tensions as they manifest themselves in the case of the City II (+ manifest, -- not manifest)

	Institutionalising	Organising Work	Enacting Technology
Aligning End Goals	Project vs. Facility +	Planned vs. emergent +	Inclusion vs. readiness +
Motivating Contribution	Individual vs. community +	Development vs. maintenance --	Research vs. production quality systems --
Designing for Use	Communities vs. Constituencies --	Research vs. development --	Today's requirements vs. tomorrow's users --

4.1.6.1 Project versus Facility (institutionalising and aligning end goals)

“Project versus facility” refers to the tension between developing an infrastructure to last for decades and the short duration or project based funding dedicated to the development.

In the City II the tension finds expression in changing project names, short duration of funding for each, and conflicting information about progress.

According to the technical supervisor of the City Survey in Dhabunagar the time given to survey land and to populate the database with owner information was nine months. This includes resolving legal disputes related to individual parcels, which he estimated to be around 60% of the cases. When asked, if this was possible, he replied: ‘Ridiculous, it is. Our principal secretary said ‘you have to squeeze this project like anything. Even a clothes dryer could not squeeze it that fast.’ ”

The City Survey is one of many programs attempting to “modernise” land tenure systems through IT based data management. The changes in program names reflect the “project-like” character of each endeavour. In 2002 a project called “Urban Bhoomi” initiated two pilot projects, which never came to fruition. In 2006 a similar pilot project took place in Belgaum District called “e-city survey.” Interview respondents often used these various project names interchangeably.

In the case of the property GIS funding was secured step by step first from the ADB and later from the WB. MRC and WB representatives explained that funding was continued, because of the state-wide uniform approach to recording and due to the progress in number of recorded properties.

Contradictory progress information about the GIS property reflects pressure to show progress. While personnel directly involved with surveying on the ground predicted that ‘this would take another ten years,’ progress presentations given to and by state-level officials offer a more optimistic picture ranging between 30% to 90% populated database. The MRC shows progress for individual municipalities on maps and charts. On one hand, these are used to identify cities with slow progress in order to discuss and put pressure on respective Commissioners to speed up work. On the other hand, the charts are published online, because ‘the public should not blame the DMA’ for delays according to one MRC representative. In sum, there is high pressure across administrative levels to show progress in populating the databases to justify project continuation and to secure funding.

At the same time there is competition between government (and non-government) agencies over available funding from different sources,

including urban development programs like Jawaharlal Nehru Urban Renewal Mission, as expressed by a state-level official from the Revenue Department: "There are so many initiatives starting in this field, because it's a money spinner, but they have to watch out that they don't get burnt."

The tension finds expression in changing project names, short-term or piecemeal funding, and conflicting progress information, but the tension is also manifest in competition between agencies over funding from various sources.

4.1.6.2 Planned vs. Emergent Organization (Organising work and aligning end goals)

This tension refers to the contradiction between carefully drafted development plans for a given project and the need for flexibility in light of unstable funding and newly emerging technologies.

In the case of the City II, the tension finds expression in incremental starting times, and differential progress in populating each database. These are in turn related to different objectives (rather than design plans) of the three efforts and to the different mandates of agencies involved in each database.

The tax MIS, implemented first had the sole objective to increase tax revenue locally through a comprehensive listing of properties and to control corruption through a database and process design that checks data entry at various stages. For example bill collectors and zonal officers' log-in allows to enter data, but changes to property parameters are permitted only for staff in the central municipal MIS office.

Requirements for statewide uniform recording of properties, which came into play slightly later, lead to conflicts between existing local system and state requirements for the property GIS. Local MIS staff expressed doubts about the need to resurvey buildings for the property GIS, because they are already listed in the tax MIS. The MRC, on the other hand, expresses concern with respect to too much local independence: "Some officials [referring to municipal Commissioners] are too motivated and we have to hold them back," because otherwise the data format does not confirm to requirements for state uniformity.

The District Commissioner (DC) of Dhabunagar explained that neither records from tax MIS, nor property GIS constitute legal tenure or land rights documents. Ideally, City Survey data would also be used for tax collection by the municipality. When asked, why both tax MIS and property GIS are being developed before the City Survey database the DC explained that:

“There is a lot of backlog [in City Survey]. But earlier this [tax MIS and property GIS] was also not there in the city corporation, even GIS was not there. They were maintaining some documents here and some there. ... At least it [GIS] has brought in some amount of accuracy. It has brought in some measure of protection. Maybe it will not hold in front of a court of law, but it serves the purpose of the corporation [tax collection].”

The MRC expressed the tension between objectives and different timings between property GIS and City Survey similarly with respect to differences in survey techniques:

“We had to start somewhere. And at that time the main objective was to increase tax revenue. For that the dimension of the property are important, the foot print. It did not matter for this purpose, if the polygon is a few feet closer or further away from the road.”

In the City II case the tension is not so much a matter of plan versus flexibility in development, but rather conflicting objectives (“plans”) between the three efforts and different starting times.

The aspiration to integrate MIS tax with property GIS, and perhaps even City Survey (although contested) has emerged more recently, but each individual effort started with a distinct objective: to increase tax revenue (tax MIS), to standardize property recording at state-level, and to computerise and map land ownership records. Accordingly different survey techniques as well as various agencies became enrolled at different times. For example, for digitalization in GIS and approval of numbering schemes, the Survey of India is involved in the property GIS process, but not in the original tax MIS survey or City Survey.

4.1.6.3 Inclusion vs. Readiness (enacting technology and aligning end goals)

In Ribes and Finholt’s case the tension of “inclusion versus readiness” refers to the infrastructure serving as an umbrella for various scientific communities and disciplines, which differ from each other in terms of their readiness to take up the technologies of the infrastructure. For instance, while one discipline may have used remote sensing technologies for a long time, another uses more field-based surveying technologies and spreadsheets.

This tension manifests itself in the City II case in two ways. First, already described differences in objectives are related to different survey techniques. Second, existing land records in paper format cannot be easily digitized, because they are ambiguous, often contested, and dispersed in different offices at local and district levels.

When properties were surveyed for the local tax MIS, it was deemed sufficient to record dimensions of the property and produce as comprehensive a list as possible of urban properties in order to increase revenue. Spatial representation of the data on maps was not a priority. The latter is a priority in the case of the property GIS. It is argued that a state-wide uniform system of spatial representation would make comparisons, updates, and monitoring of tax relevant information more transparent to state-level agencies, especially the DMA, for budgeting and planning purposes.

Therefore, property numbering takes place according to state uniform instructions and block level maps are digitised in a GIS. However, the building footprint itself is not recorded according to geographic coordinates, but in its relative position to streets. Recording of geographic coordinates of land parcel corners, however, is required for the City Survey. Accordingly, surveyors use Global Positioning System (GPS) and Total Station Survey (TSS) technology in order to reference parcel boundaries to a standard geographic reference system. At the moment ownership histories and boundaries are very situation specific. The current paper records are constructed through personal accounts and provision of multiple evidence of past land use, rights, and tenure documents. Documentation for a given parcel of land as well as its boundaries is locally and historically constructed and different for individual cases. Various documents can be used to claim rights and ownership to land, including *katha* (right to title and listed in the revenue registry) at the zonal offices in the city, land records in the Tahsildar offices especially for peri-urban areas, and an array of "proxy" documents, such as electricity bills.

The City Survey aims to eliminate this ambiguity. Paradoxically, the problem of populating the database, especially with owner information, lies precisely in the ambiguity of paper documents. A state-level Revenue Department official summarised the problem: "There are so many government agencies involved. You go to the ground and you see seven records for the same piece of land."

In survey work for the property GIS staff face similar problems with respect to socio-spatial heterogeneity and the constantly changing urban environment as these conflict with the attempts to divide the city according to uniform block and street numbering instructions:

"The blocks they took from US. There everything is straight, but here the streets go criss-cross [she points with her hands and arms in all directions]. People build new houses, add to houses, big ones, small ones, they add to the back and to the front." (MIS expert, Dhabunagar)

In addition, a wide range of semi-formal and semi-temporary arrangements, including street vendors, dhaba shops, small additions to buildings in alleys, are difficult to capture on the surveyor's maps and subsequently the database.

In sum, rather than a tension between user communities' readiness for a technology, this tension manifests itself at the level of populating each database, because digitalisation of land and property records is not straightforward, but also at the level of integrating the three databases, because each creates different data formats according to changing survey techniques.

4.1.6.4 Individual vs. Community Interests (institutionalizing and motivating contribution)

In Ribes and Finholt's case this tension refers to conflicts between the demands made on an individual as scientist and demands made upon him for the development of the infrastructure. For instance, as a scientist a person has to publish original work in her domain, but at the same time she is required to work on an infrastructure, which is supposed to serve the needs of a larger community over a long period of time.

In the case of the City II special personnel is hired or deputed for work on II—in case of the City Survey through a Public Private Partnership. In the City II the tension "individual versus community" does not express itself in terms of conflicts between two roles in one person. Rather it is a matter of individuals' interests within politico-administrative processes, and how a person perceives IT implementation to impact their position and interests. This plays out at different administrative levels.

In Dhabunagar MIS staff and GIS specialists attribute frequent changes among surveyors to low pay, unattractive work, to incorrect surveying in return for bribes and the eventual dismissal of the perpetrators. One mayor expressed the latter concern in the following manner:

"... though we have the approval from the government of India to introduce the system, ... every now and then the manual people are doing some kind of hacking, something or another... If I have to stop the corruption I cannot tell that fellow I will follow you [around]. It is exactly that thing."

Individual experience and interests at the supervision level also influence contribution to development of the City II. After the deputed expert supervising the property GIS in Mugdali was replaced by another and the IT/statistics officer died progress in property survey work came to a halt,

because the former had difficulties establishing a rapport with local staff and the latter had been replaced by a person with less experience.

At higher administrative levels, including Municipal and District Commissioners, personal interests and motivation influence not only how work proceeds locally, but also how coordination with state-level agencies takes place. Frequent transfers are problematic in both respects. In addition, different Commissioners build more or less good rapport with local administrative staff, politicians, and citizens influencing development differently in cities across the state.

Interests vary on the political side of government and are subject to election outcomes. A mayor may want to push forward work to show progress under his/her terms. Councillors may or may not be opposed to computerisation of administrative processes depending on how they perceive the processes to change politico-administrative relations between themselves, administrators, and city's residents.

The manifest tensions are summarised in comparison to Ribes and Finholt's case in table 4.1.4.

Table 4.1.4: Tensions manifest in City II case in comparison with Ribes and Finholt's e-infrastructure

	e-infrastructure	City II
Project vs. facility	Short-term project funding vs. long-term development	Same, but also competition for funding leads to new pilot projects and changing project names
Planned vs. emergent	Sticking to the development plan vs. need to be flexible and deviate from plan	Objectives for each effort, different mandates of associated agencies in each and related survey techniques come in at different times vs. aspiration to integrate the three efforts
Inclusion vs. readiness	Different readiness of user communities to take up new technology	Different survey techniques for each database, but also ambiguity of paper records and flexibility in property regimes make digitalisation as well as integration difficult
Individual vs. community	Demands on scientist vs. demands on the same person as II developer	Individual's interest and motivation vis-à-vis broader goal of computerising administrative processes

4.1.7 Discussion: A sketch of the City II problem space and its implications

Ribes and Finholt's framework offers the opportunity to contrast tensions manifest in the City II and the original cases of e-infrastructure. The aim of the following discussion of differences is to sketch out a "general problem

space" (Ribes and Finholt 2009, 380) specific to the City II development and to reflect on its implications.

Tensions manifest in the City II are mainly those related to aligning end goals. 'Project vs. facility' manifests itself very much like in Ribes and Finholt's empirical case. But in the City II there is also instability in project duration due to competition between agencies over funding sources. Other tensions related to aligning end goals present themselves differently in the City II compared to the e-infrastructure.

The "emergent versus planned" tension is evident in different starting and currently parallel timings of the three efforts, each following slightly different objectives and under agencies' different mandates. This is in turn closely related to the "inclusion vs. readiness tension." The latter finds expression in different survey techniques for each database and ambiguities of existing paper records.

The fourth tension related to motivating contribution in Ribes and Finholt's framework manifests itself in the City II in terms of individual people's interests and motivations. In the City II case we find conflicting interests among politicians, administrators, surveyors depending on their expectations with respect to computerisation. This is different to Ribes and Finholt's case. Individuals are not torn between demands made upon them as planner or administrator versus database developer. Rather it is a tension between different individuals in terms of their attitude towards digitalisation of property records and computerisation of administrative processes more generally.

Other tensions do not manifest themselves in the City II. The absence of two of them, "research vs. development" and "research vs. production of quality system" can be explained by the empirical setting. In Ribes and Finholt's case of e-infrastructure "research vs. development" refers to tensions that arise from demands made upon participants as scientists to produce original research and the basic technical work of implementing technology, such as debugging and usability testing. It is similar to the "individual vs. community" tension, but emphasizes the problem of framing the basic technical work as science research. "Research vs. production of quality system" is at the scale of technology enactment and refers to the need to develop cutting edge technology, on one hand, and provide stable and tested technology applications for current users. In contrast, the City II does not aim at developing cutting edge technology. Participants are mostly dedicated to working on technical implementation only, and do not have additional administrative tasks. The tension between "development and maintenance" does not appear, because the greatest effort is going into populating the

databases, that is surveying properties and parcels, digitizing, quality checking of data, and assigning ownership information. This is different from Ribes and Finholt's case. It is likely that the petrologists in the e-infrastructure case also face problems during field surveys to categorize minerals and interpolate boundaries of sediments. The problems of survey work itself are much more dominant in the City II case, whereas the problem of maintenance was voiced only once as a matter of who (which agency) would have final mandate to maintain the data and whether this should be at local or state-level.

More difficult to explain is the absence of two tensions related to the concern of designing for use: "communities vs. constituencies" and "today's requirements vs. tomorrow's users." In Ribes and Finholt's cases communities are the general science domain, e.g. environmental researchers, whereas constituencies refer to particular groups tied to a project, for example hydrologists and environmental engineers. The latter can shift over time as new organizations become enrolled in the project through time. The tension finds expression in participants' asking, who the community is and what it wants. "Today's requirements vs. tomorrow's users" plays out at the scale of technology enactment and refers to the visionary process of designing technologies, where tomorrow's users are a moving target as technology and practices are changing rapidly.

Questions about current versus future users are not manifest in the City II, except for some remarks at state-level to use the data in the future for urban management and planning in various state departments only after the researcher specifically asked about future use. Changes in survey techniques and anticipated conflicts for integration are usually expressed more with reference to different objectives of each of the three efforts. The user community, future or even present, was rarely discussed. This may have two reasons. One is again related to the present focus on populating the databases, where one improved technique seems to chase the next. The other may be that these issues were not raised in front of the researcher, because of larger political and economic tensions in the background. There are some indications for this. For instance, it is possible that the real estate business has an interest in making properties uniformly accessible online as indicated by one interviewee. Land developers may also have an interest to see the efforts around the City II succeed, especially the City Survey. It was expressed that the rendering of land ownership in an unambiguous way and on maps should "protect the buyer of land." Documentation for a similar project aiming to regulate urban land records through computerisation and GIS (initiated by a non-government agency, but not yet implemented) states that 'transactions on land [would] become simpler, cheaper, quicker and will be accurate and secure.' Such systems would "unlock land for development" and reduce ambiguities and inconsistencies in the current recording system.

Broadly, the problem space of the City II has three characteristics that are distinct from Ribes and Finholt's e-infrastructure. One is competition over funding and which agency gets to develop and maintain an eventually integrated database. The second are conflicts of interest between individuals at different administrative levels with respect to computerisation and digitalisation more broadly and its perceived impact on politico-administrative processes vis-à-vis a person's position in these processes. The third characteristic is the problem of conflicting survey technique requirements, on one hand, and the flexibility of urban land and property regimes, on the other.

Survey techniques for property GIS and City Survey imply a stable and categorisable space. But the city is full of "cases" that do not fit categories of formal versus informal, illegal versus legal, and does not lend itself easily to the uniform grid of a "block-street-door" hierarchy required for the property GIS. Ownership information is not a matter of mere digitalisation of existing records. Because of "flexible settings" there is not one paper record for every land parcel or building in the city but multiple and contested documents. While each technological choice (listing properties in the tax MIS vs. GIS block maps vs. GPS coordinates of parcel boundaries) deletes the progress achieved in previous surveys and/or creates divergence between databases, there is also an underlying, common drive towards more precision and elimination of ambiguities through new survey techniques.

Where participants of Ribes and Finholt's e-infrastructure are caught in tensions between the demands of the present and those for the future, the City II is in a different paradoxical situation: technology implementation struggles most with the very ambiguity and flexibility that it seeks to overcome. This is an important point to emphasize, because it sheds new light on the question of success or failure of the City II in the long run. If successful, the increases in revenue, a potential decrease in litigations and improved urban growth and land use planning may be positive outcomes. However, there is also a risk in the "success," because ambiguity and flexibility of current land and property regimes are not necessarily bad. Benjamin (2004, 179) finds that 'diversity of tenure is perhaps the single most important factor that facilitates poor groups access to productive land' in urban areas. For the case of (rural) Bhoomi Benjamin, Bhuvanewari, and Rajan (2007) provide evidence that categorising land into "wasteland" in the database ignores the function of such land for poorer groups, who cultivate it. In both Mugdali and Dhabunagar the new transparency achieved through property lists and maps also supported demolition drives of so called "illegal" constructions, including roadside shops and settlements.

Whether anticipated or not, the database categories for land and properties and unambiguous delineation (“uniform” and “accurate”) may delete those gray areas and temporary spaces. With ambiguities deleted the City II may become, in Star’s words, “not seamless subtenders of use, but barrier[s]” (1999, 380) to some groups of people.

4.1.8 Final Remark and Future Research Questions

Today’s technological choices may in the long run become embedded in the evolving City II. To some degree irreversible they may influence not only the future of II design and implementation itself, but in extension land and property regimes of the city.

This study concludes with Ribes and Finholt’s reminder to “developers and users of e-infrastructure that such choices do exist and [that it is desirable] to begin exploring their consequences” (Ribes and Finholt, 2009, 393). The City II is too recent to provide empirical evidence in terms of societal outcomes. But the findings suggest the importance for a deeper engagement among implementers as well as the public with issues that do not find much expression yet in the City II: considerations of future users and uses, and changing constituencies and communities affected by and affecting development. For research this poses two concrete questions. First, who is the community to be served by the development of the City II and in how far do their interests clash with others? Second, how will new survey techniques and IT based data management technology change the ways in which urban land and property ownership is arranged, and what are the broader socio-economic and political effects on different people?

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4.2 Enlisting SDI for Urban Planning in India: Local Practices in the Case of Slum Declaration *

4.2.1 Introduction

Initiatives to develop spatial data infrastructures (SDIs) have been taken up since the early 1990s in many countries around the world, including India. However, the spirit of global SDI convergence that dominated the 2009 GSDI conference is more of an aim for the future than an empirically grounded phenomenon. Whether or how "the walls of SDI are coming down" (Van Loenen, Besemer, and Zevenbergen 2009, pp. 1-2) remains to be seen. It is also too soon to conclude that these initiatives automatically and unequivocally lead to wider societal benefits.

Researchers of information systems and infrastructure underline that infrastructures develop in response to different local demands. They may emerge as sociotechnical constellations in a variety of ways and often with

* This section is based on (sections and figure/table numbers adjusted to thesis structure): Richter, C., G. Miscione, R. De', & K. Pfeffer (2011). Enlisting SDI for Urban Planning in India: Local Practices in the Case of Slum Declaration. In Z. Nedović-Budić, J. Cromptoets, & Y. Georgiadou (Eds.), *Spatial Data Infrastructures in Context - North South* (pp. 175-179). Boca Raton, London, New York: CRC Press. ISBN: 978-1-4398-2802-1 (Hardback). Copyright 2011 by Taylor and Francis Group, LLC.

unanticipated (positive and negative) effects (Ciborra, Braa, and Cordella 2000; Walsham, Robey, and Sahay 2007). Such variety in local place-bound circumstances and responses makes the development of large-scale systems a difficult task. In developing regions, failures of information systems outnumber successes in part due to two overlaid gaps. The first is between (Western or Western-inspired) design context and the “local actuality of the users” and the second between “hard” rational design and “soft” political and behavioral actuality (Heeks 2002). In the case of SDI, what are these design–local actuality gaps in different contexts around the world? We address this question for the case of urban India by confronting the expected role of SDI with local planning practices in a southern Indian city.

In this work we refer to “SDI development” as the overall endeavor of designing, implementing, using, and evaluating SDI. In analyzing local planning practice, we view SDI development through what Star and Ruhleder (1994) call an “infrastructural inversion ... [which] de-emphasizes things or people as the only causes of change, and focuses on infrastructural relations ... and reveals how choices and politics embedded in such systems become articulated components” (p. 253). Instead of predefining various components of SDI (e.g., data, networks, and copyrights) or the roles of stakeholders in SDI development (e.g., users, providers, and managers), we put the local context into the foreground—more specifically, the current dynamic relations between people, their work, and embedded information in paper and digital form.

We first provide a theoretical sketch of the role SDIs are expected to play locally. We then examine the planning context of an Indian city and its practices in the slum declaration process through an analytical lens borrowed from Mol and Law (2002). This approach helps to explain the interplay of various actors and the multiplicity of representations in lists and drawings (of slum areas and inhabitants) created in this process. We then compare our findings with SDI expectations and discuss the implications for future SDI development at the local level. Finally, we address limitations of this study, as well as its contribution to future research.

4.2.2 SDI Research and expectations

In the following section we explain the need to bring local practice to the foreground in SDI research and we sketch out the expected role of SDI locally.

4.2.2.1 The Missing Context of SDI Development: Local Practices

The development of spatial data infrastructure involves data, people, networks, and data access and sharing policies, as well as legal issues related to data rights, ownership, and privacy. Current approaches to SDI research

seek to capture these aspects as well as the dynamics of SDI by means of increasingly elaborate sets of indicators. These are used to evaluate countries' readiness to undertake SDI (T. Delgado Fernández, M. Delgado Fernández, and Espín Andrade 2008), the national status of SDIs (Eelderink, Crompvoets, and De Man 2008; Vandenbroucke, Janssen, and Van Orshoven 2008), and SDI performance or its ability to deliver promised benefits and outputs (Giff 2008; Janssen 2008; Steudler, Rajabifard, and Williamson 2008). In these approaches, SDI is viewed as a framework that links various components at different scales—for example:

- data, people, and networks (Rajabifard 2008, p. 13)
- policy, data, people, and networks (Steudler et al. 2008, p. 205)
- data users and providers (Janssen 2008, p. 262)
- different administrative levels of government and nongovernmental organizations (NGOs) and sectors (Masser, Rajabifard, and Williamson 2007, p. 10).

These approaches are rather data centric. Social dimensions, especially, are considered only as factors influencing data dissemination and use. People and their relation to information are usually summarized as “human resources,” “people component,” “stakeholders,” or simply “people.” Keeping (potential) stakeholders and their practices in the background is problematic because, as Nedovic-Budic, Pinto, and Raj Budhathoki (2008) note, “[u]ser concerns and the level of use of an innovation ... do not exist in a vacuum” (p. 278).

Some studies offer a deeper understanding of the relations between people and SDI. For instance, they examine the roles and perceptions of different stakeholders in the Indian National SDI development (Georgiadou, Puri, and Sahay 2005; Puri 2006; Puri, Sahay, and Georgiadou 2007), personal characteristics of key individuals driving SDI in the Minnesota SDI (United States; Craig 2005), or how SDI practitioners themselves evaluate their development efforts (Lance, Georgiadou, and Bregt 2006; Lance 2008).

Data sharing studies, particularly, investigate the relation between people's practices and information. Elwood's (2007) research in Chicago, Illinois, shows how land use data sets from the municipality are of little use to grassroots organizations because of differences in the epistemologies that stem from the NGO's objectives and day-to-day practice. Schuurman and Leszczynski (2006) and Schuurman (2005) explain how differences in land use classifications of two county government databases are embedded in different planning practices and rationales, making the data ontologically incomparable despite achieving technical interoperability.

A few studies focus on the relations between people's practices and newly introduced technology within a specific local context (Harvey, 2006, and

Silva, 2007, for digital cadastre and land administration systems, respectively). In India, Puri et al. (2007) emphasize the importance of locally relevant hardware and software and the need to recognize multiple stakeholders and exercise social sensitivity for the success of several local technological initiatives. De' (2006, 2008, 2009) investigates the relationship between caste structure and e-governance projects in India and finds that the systems favor dominant castes in terms of design and benefits. These researchers explicitly address existing relations between people and land as they have developed historically in a specific context. An understanding of these historical contingencies allows researchers to investigate how system implementation shapes and is shaped by existing practices (in land administration, for example).

The paucity in SDI research addressing the relations between SDI and people's practices within specific local contexts is problematic in three ways. First, there is evidence that existing practices play an important role in the trajectory SDI development takes. For instance, Davis and Fonseca (2006) note that the "success [of SDI] has primarily been a result of reaching wide agreements on principles and practices, always guided by real needs and applications" (p. 288); Harvey and Tulloch (2006) emphasize that data sharing does not happen in and for itself, but is always part of other activities. Neglecting the local context of SDI development also makes it tempting to apply standard indicators of success and failure across diverse settings and situations globally, while various settings may pose different challenges and opportunities.

Second, the knowledge of local context can facilitate the identification of opportunities for local institutionalization without having to assume that geographic information types and uses play the same role everywhere. For example, in our research we find that local address systems rely heavily on landmark descriptions and that photographs of construction sites play a more important role in planning and budget meetings than thematic or topographic maps.

Third, an understanding of existing local practice is necessary to assess how far SDI development can address wider social goals, like management of disasters, resources, and environment; alleviation of poverty; or access to land, housing, and physical infrastructure.

The need for more sensitivity to the context has been noted elsewhere. Nedovic-Budic' et al. (2008) suggest that evaluations of SDI ought to be carried out in conjunction with contextual factors and determinants of outcomes. Georgiadou and Stoter (2008) explain the need to study the dynamic relations between social context and geoICT in use through

longitudinal, interpretive and in-depth case studies. For information and communication technology (ICT) in general, Prakash and De' (2007) emphasize how the context influences the value of ICT to socioeconomic development outcomes. Although her recent book is titled "e-Governance for Development—A Focus on Rural India" (2009), Madon chooses to put "greater emphasis on governance and development, rather than on the 'e' [because of] the important role played by local governance structures in addressing the development needs of the community" (p. 6).

In places where SDI is only emerging or where state and national SDI efforts have not touched the ground yet, various fields of practice (for example resource management, administration, or planning) can provide contextual boundaries for data collection and analysis. We focus on people's practices in local urban planning. In order to analyze these practices in a way relevant for local SDI development, we first sketch out the expected role for SDI locally. To do this, we have to rely on Indian SDI strategy documents for the national and state-level.

4.2.2.2 SDI's Expected Role as Ordering Mechanism

The aim of this section is to provide a theoretical sketch of the expected role of SDI locally. We review the 2001 Indian NSDI Action Strategy Plan (GoI-DST, 2001) and the 2008 Progress Report for the state SDI²⁹. We draw mainly on a section in the NSDI document called "Spatial Information—Indian Perspective" because this section provides insights about the type of geographic information, its expected use, and locally involved actors.

The state SDI was launched at the NSDI-11 conference in Pune in 2009 as the second state geo-portal in India after the New Delhi geo-portal. Sanctioned in April 2007, it is a joint initiative of the Natural Resources Data Management System (NRDMS), the national Department of Science and Technology (GoI-DST), and the state government. The state geo-portal seeks to support interagency data sharing through a common platform, identify the needs of various government programs, and facilitate decision making and local-level planning. In the following we make these expectations for the local role of SDI more specific. The state SDI is expected to support the collection and integration of geographic information about various aspects of the world. In the Indian documents, there is strong emphasis on the use of geographic information systems technology allowing users to "crunch together" data and

²⁹ To retain anonymity of informants, we do not cite exact names of this Indian state and refer to the state as "state" in document names in the text. The Action Strategy Plan was chosen over a more recent account of the Indian NSDI efforts because the former outlines expectations and a course of action. The progress report for the state geo-portal is relevant because the city we study is located in this state and the document is the most coherent source available at the time of writing.

process maps to provide spatial visualization of information (GoI-DST, 2001, p. 1.2).

The outcome of such assemblage is to be “used for a wide range of applications—natural resources management, wasteland development, watershed development, urban management, coastal management, utilities management, infrastructure development, business development, etc.” (DST, 2001, p. 3.1).

Outcomes of information integration must be considered representations of the world—for example, representative of all areas that are most prone to flood in a given country or inclusive of all corridors with low and medium traffic volumes for a given urban area. Although GIS offers the opportunity for users of information to “become mappers” and “many possible mappings could be made,” mapping “still depends upon a representational view of the world” (Kitchin, Perkins, and Dodge 2009, pp. 7–8). The third message in the documents relates to the actors expected to assemble geographic information locally. For the NSDI, the government is viewed as the major enabler (GOI 2001, pp. 5.1–5.2).

According to the progress report for the state geo-portal (State Council for Science and Technology 2008), assemblers of information are the offices of public administration and associated organizations (the document also lists state-level boards). Specifically, for local planning in cities, the assembler is expected to be the urban local body: “The process and practice of infrastructure management are being decentralized to the PRI’s/Urban Local Bodies (ULBs) in order to make the related strategies area-specific and responsive to the local aspirations and needs” (State Council for Science and Technology 2008).

We can sum up three key expectations for the role of the Indian SDI locally:

- To collect and combine geographic information about the world (e.g., city, region, and state)
- To produce outputs from data combination in GIS—for example, as thematic maps—that are representations of the world (domain or application specific) to be used in management, planning, and decision making
- To connect to the local level, where mainly formal organizations of the public administration, especially the urban local bodies, are responsible for collecting and combining geographic information for use in urban planning (at least initially)

The underlying rationale of these three key expectations can be conceptualized through Mol and Law's (2002) concept of order. Orders in this sense "do not simply expel the complex and chaotic. In addition, they insist that what belongs to them is drawn together and properly assembled. No element may hold back, and what is inside must be named, accorded a place" (pp. 13–14). Information is not randomly grouped together. In ordering, the aim is to assemble elements to fit into a larger scheme. The data in GIS tables and remotely sensed images and on maps are then viewed as representations of some aspect of the world (flood-prone areas, low-traffic streets, etc.). Mol and Law (2002) identify three modes of representation from which order emerges. SDI's expected role as ordering mechanism involves two of these modes.

One is the classificatory system. A table or database that classifies "presupposes a single and conformable world ... and makes big cages that are then subdivided into smaller ones" (Mol and Law 2002, p. 14). An example of a classificatory system as mode of representation is land use classification. The aim is to include every possible land use, and this is done through hierarchical nesting of land use categories. The first level may be residential, industrial, commercial, and open space. The second level is low- and high-density residential areas, light and heavy industry, and so forth. The classification insists on properly assembling these elements and being all inclusive and hence representative of the world with respect to land use.

Maps are the second mode of representation relevant for SDI. They are not necessarily classifications, but rather "draw surfaces that contain details," sites, and their attributes, "that are related in an accountable manner" (Mol and Law 2002, p. 16).

The SDI's expected role locally can be conceptualized as an ordering mechanism. The assemblage of geographic information through GIS in public administration would draw on two modes of representation: classificatory system and maps.

The goal of gaining an all-inclusive overview does not mean that geographic information assemblage is expected to include and represent all of reality. Instead, "order" refers to an underlying rationale, where information is assembled in such a way that it is all inclusive with respect to certain application domains (e.g., land use planning) and where outcomes of assemblage are representative for this specific aspect of the world (e.g., land use).

We will return to the implications of conceptualizing the role of SDI as ordering mechanism later in the section. In the following section we describe the research methodology and then analyze existing local planning practices.

4.2.3 Methodology

4.2.3.1 Empirical Case

The context for our study of local practices is the realm of urban planning. The empirical case concerns the identification and declaration of slum areas. Slum declaration has had direct implications for the spatial allocation of funds under poverty and housing schemes since the 1970s. It is part of the larger process of slum improvement and rehabilitation. Planning here is not the practice of expert planners or the department of planning. Instead, it involves the work of various municipal and state departments, parastatal boards, and nongovernmental actors.

At the time of research, Mugdali was part of a major national urban renewal mission initiated in 2005 and scheduled to run for 7 years. Slum rehabilitation forms the focus of the second of two subprograms in the mission and entails provision of housing and physical infrastructure specifically for slum areas. The listing of declared and undeclared slums plays a central role in these activities because rehabilitation relies on the identification and declaration of areas to be rehabilitated. "Undeclared" refers to areas that are known to be slums, but are not officially declared. "Declared" means that the area is officially declared as a slum. Per mandate, the implementing agency for rehabilitation³⁰ work is the State Slum Clearance Board, established in 1975 through the State Slum Areas Act of 1973³¹.

4.2.3.2 Research Approach

Our research approach is exploratory and interpretive (Walsham 2006) because the empirical field is historically, culturally, and linguistically different from the geographical locations where the notion of SDI was first conceived—namely, in North America (Homburg and Georgiadou 2009). The time frame of this study allows us to spend extended periods in India. We are able to gather descriptions from different perspectives and go beyond what people say by observing what they do (Silverman 1998). We generate questions in

³⁰ The language with respect to slum "rehabilitation" has changed during the past 40 years, depending on policy goals, from "clearance" to "improvement" and currently "rehabilitation." The latest terminology seeks to reflect policy and funding preferences for in situ development and provision of social services instead of area clearance and relocation.

³¹ What we call the "slum office" is a divisional office of the State Slum Board. The office responsible for slum in three districts including Mugdali.

an ongoing manner and follow new insights in order to build explanations gradually. We draw on 7 months of ethnographic fieldwork in Mugdali, in southern India. The empirical findings presented here are derived from three main data sources:

- Government documents, especially the 1973 Slum Clearance Act³²
- Semi-structured interviews and informal conversations with officials and staff at the local slum office and municipal office (urban local body), ward councilors (politicians), and others
- Notes from field observations

The first author spent, on average, 5 hours per week in the slum office, an adjacent rehabilitated slum, and a small, convenient shop in front of the slum office to gain insights into the work taking place at the office and into its connections to other actors. The research team shadowed slum office surveyors during their socioeconomic survey in one declared slum and visited 14 declared slums, two migrant camps, and one undeclared slum area repeatedly for transect walks, mapping, and interviews with dwellers³³, leaders, associations, and women self-help groups. Interviews were also conducted with representatives from two NGOs active in slum organizing and improvement and one NGO funding organization³⁴. During the first 3 months, the researchers attended weekly review meetings for the urban renewal program at the municipal office.

In addition to field notes, a field diary and interpretations/hypotheses were kept separately during fieldwork in order to ensure reliability of analysis. To exclude empirical data unrelated to slum rehabilitation activities, the analysis was performed only on dates from the field notes in which "slum" was mentioned.

For analysis, we first wrote three detailed descriptions of the declaration process from different perspectives: the process as described by slum officials and Slum Clearance Act; detailed summaries of our observations, accompanied by photographs; and a description based on information artifacts created in the process (e.g., list of declared slums, list of beneficiaries, and boundary drawings).

³² This act outlines procedures for declaration and definition criteria. It is often cited by slum officials and was used for analysis in conjunction with procedure descriptions in interviews.

³³ We use the word "dwellers" because it is locally used to refer to people who live in (declared and undeclared) slum areas (in English conversation).

³⁴ One interview was conducted in May 2009 with one representative from each organization in their offices in Mugdali. One of the interviewees invited us for a site visit to a slum recently included in the NGO's youth program. We interviewed the representative from the funding organization twice over tea in a roadside hotel.

4.2.3.3 Analytical Lens

Based on these descriptions, we categorized practices according to Mol and Law's (2002) concept of lists that classify (based on classificatory system) and lists that do not classify. If we read a list that is based on some kind of classificatory system, we can understand an underlying set of criteria. It may order the world by size, by genetic similarity, by elevation and slope, etc. At the same time, such a list seeks to represent aspects of the world drawing on classificatory systems. In the following, we call the practices that bring about such lists "classificatory listings."

But a list does not have to classify and does not have to seek to impose a single order onto the world. Here, Mol and Law give the example of a Chinese encyclopedia³⁵ that divides animals into categories like "stray dogs" and "drawn with a very fine camelhair brush" (2002, p. 14). Such a list does not classify, at least not in any recognizable way. It only groups together without relying on any single logic of ordering. According to Mol and Law, "Items in [such] a list are not necessarily responses to the same questions but may hang together in other ways, for instance socially, because [such] a list may be the result of the work of different people who have each added something to it" (p. 14). That is, "they assemble elements that do not necessarily fit together into some larger scheme [and] they make no claims to inclusiveness" (p. 7). In the following discussion, we call the practices that bring about such lists "nonclassificatory listings."

We use the term "listings" in order to make explicit what people are actively doing (listing). Listings are the practices through which lists and maps of slums and inhabitants are created and used. The dichotomy of classificatory/nonclassificatory serves as a sense-making tool to analyze the practices in which information artifacts are embedded.

4.2.4 Findings

We describe the two listings separately and explain how far they are classificatory and nonclassificatory. However, the process of slum declaration must be understood as the interplay of both listings and information artifacts must be viewed as outcomes of this interplay.

4.2.4.1 Classificatory Listings

One set of practices is driven by public administration procedure and staff. It follows legal and monitoring requirements, which also determine the types of information artifacts required for official declaration.

³⁵ Foucault, in "The Order of Things," borrows this example from Borges.

The slum office learns about an area (undeclared, but known) through NGOs and slum dweller associations, who visit the slum office or ULB. An NGO might also provide this information to the deputy (district) commissioner (DC), who then forwards it to the slum office. Surveyors visit these sites to prepare information required for declaration—namely, a boundary drawing of the area (by hand and measuring tape) and a beneficiary list with socioeconomic data (SES survey form) for each household that is either signed or fingerprinted by the household head. Slum officials check the area against legal requirements for slum declaration, where:

... the Government is satisfied that,

- (a) any area is or is likely to be a source of danger to health, safety or convenience of the public of that area or of its neighborhood, by reason of the area being low-lying, insanitary, squalid, overcrowded or otherwise [*sic*]; or
- (b) the buildings in any area, used or intended to be used for human habitation are, (i) in any respects, unfit for human habitation; or (ii) by reason of dilapidation, over-crowding, faulty arrangement and design of such buildings, narrowness or faulty arrangement of streets, lack of ventilation, light or sanitation facilities, or any combination of these factors, detrimental to safety, health or morals, it may, by notification, declare such area to be a slum area. (State Slum Areas [Improvement and Clearance] Act 1973, Chapter 2)

In interviews, the term “unfit for human habitation” is often expressed as “the houses are not pucca.” “Pucca” roughly translates into “solid/permanent.” In this case, “not pucca” refers to various physical housing characteristics, such as lack of ventilation, thatched roofs instead of metal roofs, and dirt floors. Slum officials also cite 10–15 as the minimum number of dwelling units to constitute a slum area. In addition, the surveyors check (and this can take several months) voters’ lists or ration cards to evaluate length of stay of a household for eligibility. To be included in the beneficiaries’ list, legal requirements must be met according to the 2004 State Slum Act Amendment Rules.

The list of beneficiaries with socioeconomic data and boundary drawings is reviewed by the assistant executive engineer (AEE) in the slum office and submitted to the ULB to receive no objection certificates as well as to the state-level slum board office for approval. From there it goes to the DC, who issues a declaration by publishing the area’s name in a gazetteer.

These practices in response to procedural and legal requirements are driven by the goal to order through classification. The underlying rationale has at its core three “cages” (to use Mol and Law’s terminology): from city to area

(based on Slum Act criteria) to individual households (based on Slum Act Amendment criteria). The objective is to identify and declare all areas and people that match these criteria — that is, to be all inclusive and to create a list representing all slum areas, dwellers, and their characteristics in Mugdali per established criteria.

Although the slum office forms a nodal point for these activities, it also involves the board's state office, several consultants, the ULB, the DC office, and, especially during land disputes, the urban development agency and courts. In other words, these practices are driven mainly by procedure and staff of the public administration. The content of information artifacts, however, varies and can be highly contested, as we witnessed in review meetings. There are, in fact, multiple representations, and no list can claim an all-inclusive overview of slums in Mugdali. This can be explained by practices beyond those driven by procedure.

4.2.4.2 Nonclassificatory Listings

Information artifacts are at the same time an outcome of practices of people outside public administration and the relations between them, public administration, and the urban environment, like land and temples. These practices are not driven by an underlying aim to order (through classification). Instead, "if someone comes along with something to add to the list, something that emerges as important, it may indeed be added to it" (Mol and Law 2002, p. 14). There is no one entity or criterion that decides what is important to be added to the list. New criteria emerge as important in these practices depending on changing sociopolitical situations.

The most frequent visitors at the office are leaders of the umbrella organization of slum dwellers, who negotiate throughout the process of declaration and lobby for inclusion of new areas and individual beneficiaries on lists. Leaders of individual areas and their respective associations also come directly to the office to "give presentations about their case," as an official said. Slum dwellers may approach the office with their own boundary drawings and lists of beneficiaries. Throughout the week, groups of people wait at the office to meet officials and become listed as beneficiaries.

During socioeconomic surveys in slums, officials not only write lists of houses and families, but residents also keep lists and provide this information to officials. In these cases, the dwellers (through associations, usually) directly add or seek to add to various official lists of known slums, of declared slums in the longer term, and of beneficiaries. Now the cages of classification (city–area–household) become blurred. The people and areas that are supposed to be classified based on a set of criteria participate in the creation and changing of lists, but not in an ordered fashion. The aim here is not to create

an all-inclusive representative list. Practice is driven by varying objectives with respect to specific areas, groups of people, and individuals.

What these objectives are and how they can be pursued is influenced by emerging associations, knowledge of opportunities, and an area's distance to the slum office. As one of the shop owners in front of the office explained to us, it is easier to come to the office regularly to "put pressure on officials" (to move forward the process of declaration and subsequent rehabilitation) if one lives closer because of travel cost and time. "That is why you see many declared slums around the office" (see also figure 4.2.1).

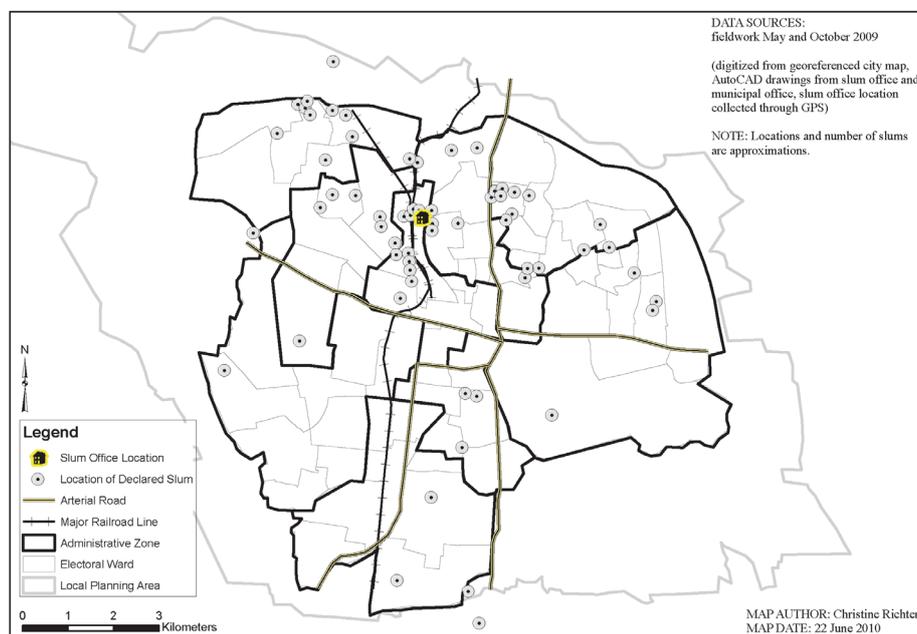


Figure 4.2.1: Location of slum office and declared slums (approximate location and number).

What happens around the slum and other public administration offices is linked to the less visible backstage work. The AEE attributes the increase in slum declarations over the years to the work of NGOs, which raise awareness among Mugdali's urban poor to access various national and international program funds and services. Members of NGOs also emphasize that money management and substance abuse are of special concern in slum areas—more so than levels of income. There are, then, socioeconomic criteria other than the physical criteria stipulated in legislation that carry relevance and influence which areas are brought to the attention of public administration and become listed.

When we enter backstage politics, the listings become difficult to trace. Here, “things hang together” in less predictable ways and emerge from different social relations. During a site visit with one of the site engineers to a recently declared slum, we asked how the slum office came to know about this area. We learned that a member of the legislative assembly (MLA), a state-level politician, approached the office on behalf of the people. MLAs also approach state-level bureaucrats with the aim of listing party workers as beneficiaries if they live in slums. In exchange, the politician may influence the transfer of bureaucrats between public administration posts. Local-level politicians (for example, ward councilors) also enter into socio-political relations with slum dwellers, leaders, and public administration in return for votes. Text Box 4.2.1 shows excerpts from an interview with a local Congress party leader and ex-ward councilor that sheds light onto these relations from her perspective.

Whether an area becomes included in the list of declared slums also depends on land ownership and rights. It is more difficult if the slum is located on privately owned land because, in this case, people have to be relocated and may oppose declaration because it entails a move away from jobs and relatives.

Excerpts from an Interview with a Local Party Leader:

(A) Why one slum was declared (and infrastructure provided) and the other not, she explains:

Here in [slum A] the MLC [Member of Legislative Council] M.G. was there. He constructed them houses from the government fund. ... They have nice facilities like water, light, and all underground facility. Everything is ok for them. But these people [referring to a different undeclared slum], they cannot sleep in the night; snakes and scorpions will come ... Rainwater passes through their house. I don't know how they live.

(B) Intermediaries may also be politicians running for office at ward level. In many cases, politicians promise dwellers declaration of their area and/or provision of services in order to capture the votes of area residents. Slum dwellers may approach the politician according to the interviewee:

How do I know about the people? When elections come, they come to our door ... They will know the candidate, who is the candidate for my area, so they will come to our door [and they say:] "You come and see my place. We need this much of work. And we are so many there, you have to give money." That is how they demand. Most slum people will vote; 90% of the people [from a slum] will come and vote. But they make demands [in return].

(C) Negotiations over money, votes, and services take place between politicians, slum leaders and public administration:

Researcher: Do you know how one person in a slum becomes the "senior"?

Politician: Because they have stayed there the longest. And then they start collecting [a type of rent from other dwellers].

Researcher: Do you think some corporators [ward councilors] support these senior people in the slum?

Politician: For the vote purpose, but they have to be silent.

Researcher: The longer they live there, the more senior they are and then they start collecting?

Politician: He [senior] is the boss now and he will tell every person whom to vote for ... He comes for everything. Like how much money has to be given per vote, what all the things are that have to be provided in return, what facilities. He will also talk to the government about that. All the others [slum dwellers] are under his control.

Researcher: He acts a little bit like an elected person then, but he is not elected?

Politician: Yes, yes.

Researcher: He is only senior?

Politician: Yes. But they also elect within their slum. If there are two persons competing, they will hold an election.

Text box 4.2.1: Insights into the relations between politicians, slums, and public administration from the perspective of a local political leader

Length of stay directly influences whether residents are included in beneficiary lists, but this may in turn be an outcome of the interplay between political relations, relations to land, and socioreligious practices (as the example of temple construction shows). To interrupt a direct relation between voters (slum dwellers) and local leaders or politicians while securing the area as a vote bank, the politicians may introduce a third figure—namely, a god or goddess—through temple construction (Beck 1976; Brouwer 2004, 2007). The temple in turn makes it possible for people to stay on the land for extended periods of time because it is complicated to shift after construction.

Compared to the more procedure-driven classificatory listings, the practices that we describe here as nonclassificatory listings are more situational and ad hoc in nature, with different criteria and actors emerging through time. The nonclassificatory listings explain why it is difficult to recognize a single underlying ordering rationale that determines what is included in the lists. They explain the variability in content and also contesting versions of lists of slums in the city. Nonclassificatory listings outside public administration merge into the classificatory listings (and vice versa), forming a dynamic dialogue from which lists emerge that cannot completely fulfill their promise of comprehensively representing the world (all slums and characteristics in Mugdali). The intertwining of these two “listings” is reflected in figure 4.2.2. The photo illustrates the attempts on the part of the public administration to represent the same door once and for all on the list (the survey form).



Figure 4.2.2 : repeated survey numbers on door in declared slum. (photo: C. Richter, May 22, 2009.)

We are left with three numbers on one door and one door being recorded at least three times. This becomes plausible and explainable only when we take the interplay of both listings into consideration—an interplay characterized by shifting sociopolitical alliances and relations between people, land, and built environment.

4.2.5 Implications of findings for local SDI Development

Part of the process of slum declaration is driven by public administration procedure and staff. Information assemblage in these classificatory listings follows a rationale of order through modes of representation—specifically, classificatory systems and mapping (lists of slums and beneficiaries, boundary drawings). The expected role of SDI as ordering mechanism fits these practices. It would serve public administration in collecting and combining information in a comprehensive manner according to specified criteria and definitions of areas and people, and in turn to create representations of slums in databases and on maps.

However, actual practices in the process follow procedure (and its rationale) only partially. Classificatory and nonclassificatory listings intermingle; the assemblage of information does not rest solely in the hands of public administration. Slum dwellers, NGOs, and other organizations are not silent and passive data sources. Through nonclassificatory listings, they engage in the creation of lists, add to tables, and change boundaries. From the point of view of SDI as an ordering mechanism, these nonclassificatory listings pose an obstacle to an all-inclusive and representative view of slums and inhabitants in Mugdali on final table or map.

Table 4.2.1: Expected Role of SDI and Local Context

Expected role of SDI	Local context
To collect and combine geographic information about the world (city, region, state, domain specific).	There is <i>no clear-cut separation between geographic information about the world</i> (number of dwellers per area, slum boundaries), the world, and the activities of combining information.
To produce outputs from data combination in GIS—for example, thematic maps, which <i>represent</i> aspects of the world and provide a basis for management, planning, and decision making.	Lists of slums/beneficiaries are <i>not a 1:1 representation</i> of slums/beneficiaries in a city, because lists change, are contested, and (re-) created through the interplay of classificatory and nonclassificatory listings.
To connect to the local level, where mainly formal organizations of the <i>public administration</i> , especially the urban local bodies, are responsible for collecting and combining geographic information for use in urban planning (at least initially).	There are <i>others who collect and combine</i> information, including dwellers and NGOs, and the associations they form with politicians and urban environment. Assemblage is not contained within formal organizational boundaries.

Presently, the interplay of classificatory and nonclassificatory listings creates multiple and competing versions of slum areas and characteristics, preventing any one representation to claim dominance over an extended period of time. Specifically, for the case of slum declaration and related planning of poverty alleviation and housing programs, SDI expectations also face the problem of shifting control over the assemblage of information *within* public administration—namely, from the slum board to the ULB. We have summarized the reflection between expected SDI role and local context in Table 4.2.1.

SDI development at the local level cannot be reduced to issues of ICT capacity and the development of technical standards and data sets. Instead, it may affect and require changes in planning practices, underlying rationales, and potential stakeholder roles. We discuss possible implications for SDI implementation: one in its (expected) administrative ordering role and one in an alternative, more open and flexible approach.

Local SDI development that would follow the outlined expectations for SDI as an ordering mechanism favors and encourages the practices which we identified as classificatory listings through GIS mapping. These practices are viewed separately from nonclassificatory listings, and the latter are excluded from the assemblage of information. Information gathering and other related activities are firmly centered within public administration—for example, a municipal GIS department. The role of people and their associations with each other and with the urban environment (land, temples) are removed from the realm of data assemblage. Public administration offices—specifically, the ULB office—are turned into “centers of calculation” where “observations are accumulated, synthesized, and analyzed” (Kitchin et al. 2009, p. 16) with the aid of GIS technology. If classificatory listings gain dominance, so would specific representations of the city, its slums, and residents. Those representations would be based on official government procedures and views as opposed to representations that encompass multiple perspectives and versions of reality.

A push toward classificatory rationale and control vested more strongly in the hands of public administration may have positive or negative consequences. On the one hand, the disregard for direct relationships between dwellers and street-level bureaucrats can lead to a loss of venues for negotiation. Street-level staff’s and citizen organizations’ intimate knowledge of the dynamic sociospatial and political relations is not included or at best moved into the background and “rigidized” in GIS databases. On the other hand, an expanded mode of classification may include areas and people who are currently ignored because they lack the opportunity to participate in either

classificatory or nonclassificatory listings (e.g., migrants who do not speak the local language or who cannot access associations due to stigmatization).

Alternatively, the expected role of SDI could be more broadly conceived or changed during development through a more flexible approach. With the more open approach to SDI development, types of geographic information (e.g., dwellers per area), roles of stakeholders (NGOs and politicians as data providers), and identity of assemblers (ULB) are not predefined firmly. Instead, development would follow an “infrastructuring” approach (Pipek and Wulf 2008). In infrastructuring design, implementation, use, and evaluation are not distinct steps in a linear process and the roles of designers, implementers, and users are not fully separated. Instead, boundaries between the steps and roles in SDI development become blurred. The system is designed through use; in turn, use designs the system.

Such an approach would be neither purely “top down” nor “bottom up.” The decisions of expert designers about the roles of various SDI stakeholders are replaced by opportunities for actors to shape³⁶ their own roles vis-à-vis geographic information during development. What emerges as SDI locally may be quite different from northern or Indian national and state notions and expectations. Such an approach would also require more flexible evaluation of SDI that allows assessment criteria and indicators of success or failure to emerge during infrastructuring from the specific context and based on wider societal goals in this context. The impacts of SDI development on planning practices and changes in stakeholder roles may receive more consideration under the open SDI scenario.

4.2.6 Research limitations and Further Research

In this section we focused solely on the process of slum declaration. Further research is needed to investigate our findings with respect to the wider realm of urban planning and with respect to explicit local geo-ICT development efforts. Through our analysis of practices, we shed light onto the relations between people, land, environment, and information artifacts. Contesting representations of the world cannot be explained quickly by factors such as lack of comprehensive data sets or irregular table updates.

However, this study is weak with respect to Klein and Myer’s (1999) fourth principle for evaluation of interpretive research: the application of findings “to more general concepts (theory) that describe the nature of human understanding and social action” (p. 72). In other words, future research needs to explain why these two rationales intermingle. In addition, the

³⁶ The term “shape” here reflects the contingent, emergent, reactive nature of the activity rather than forethought and planning as suggested by the word “design.”

theoretical sketch of SDI's expected role locally is based on key messages from two Indian SDI documents only. Future research needs to investigate further the expectations embedded in the development and discourse of national and state SDI.

Our main contribution lies in the identification of a boundary never tackled in SDI development literature—namely, that between two rationales that mix in practice. SDI research so far has mostly addressed the objective of seamless integration of geographic information (socially and technically) and information systems vertically and horizontally. From this point of view, SDI research tends to regard heterogeneity of information (e.g., lists) as indicative of clashing classifications, which in turn are perceived to arise from different organizational mandates and procedures. For example, an organization with the objective of managing land slide risk may classify land cover differently than an organization concerned with the appropriate distribution of urban land uses. In support of comprehensive and rationalist planning, SDI would require the standardization and/or interoperability between classifications through technical solutions and through interorganizational coordination and agreements.

However, our analysis shows that information creation and use fall along a boundary of practices where one is driven by a classificatory rationale, but the other is not. The latter does not seek to order through representation according to specific definitions or criteria, but rather is driven by changing and situation-dependent objectives and alliances. It functions in part on the basis of inconsistency and heterogeneity. At the same time, the boundary between these two rationales does not necessarily align with any formal organizational boundary, nor do the two listings coincide with a state–citizen dichotomy. A public administrator may follow procedure today and follow political relations tomorrow, depending on objectives and strategies.

In conclusion, future SDI research should not only search for solutions to standardize existing information or seek to explain different classifications and definitions, but also explore the rationales and objectives of people's practices that do not easily align with organizational mandates, procedures, or even formal organizational boundaries. Questions arising for such research may include:

Do people who adapt or drive SDI initiatives rely on the rationale of classification (in discourse and practice), on nonclassificatory rationales and sociopolitical alliances, or a mix of both?

What does that mean for the two-directional shaping between SDI development and urban planning practices?

Will practice become more classificatory or will SDI become less classificatory—for example, serving as a discursive device only?

The aim of such research is to trace the incorporation of new technology into the realm of wider practices to learn and to explain how these are shaped by and are shaping technology and what the consequences might be.

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4.3 Practices of Legibility Making in Indian Cities: Property Mapping Through Geographic Information Systems and Slum Listing in Government Schemes*

Abstract

Property mapping through use of geographic information systems (GIS) and slum listing are practices of official knowledge production in government improvement schemes in Indian cities. Our comparative analysis of these two practices is in concert with recent amplifications of Scott's analytical scheme around the notion of legibility making. In both cases knowledge production in practice encounters an "amorphous state." Government representatives and interests frequently intermingle with non-governmental representatives and interests. This influences knowledge production in practice with different implications for government scheme implementation and participation in urban governance. We find that slum listing supports scheme implementation better than GIS property mapping. The latter seeks to translate the notion of a clear delineation between state and non-state into organizational and technical design for legibility making. It stops short of reaching larger aims of the scheme and comes to focus on the problem of incomplete knowledge and mechanisms of self-referential monitoring. The more organic practice of slum listing involves dispersed paper and desktop technologies and relies on traditional sites of knowledge production in the city. It is adjusted to and enacted by an amorphous state. The official knowledge produced is temporary in nature, and as such allows for incremental and partially reversible scheme implementation. Slum listing retains channels of negotiation with city administration and politicians, which are vital for poorer sections of the urban populace. Our study is relevant to policy and future research, because as of 2012 the new national slum improvement scheme requires implementation of GIS also for slum data collection and management. The question is, whether the new scheme will run into similar problems as GIS property mapping or whether it puts at risk existing channels of negotiation.

4.3.1 Introduction

Up-to-date information on the territory and people in a state is a core ingredient for the implementation and evaluation of government-driven improvement schemes. Standardized, unambiguous and comprehensive information enhances the capacity of administrative cadres to "see" the

* This section is based on (sections and figure/table numbers adjusted to thesis structure): Richter, C. & Y. Georgiadou (2014). Practices of Legibility making in Indian Cities: Property Mapping Through Geographic Information Systems (GIS) and Slum Listing in Government Schemes. *Information Technology for Development*. DOI: 10.1080/02681102.2014.886548.

territory and improve the welfare of the people (Scott, 1998). Information technology (IT) has promised to support these endeavors since the dawn of the information age (Tsoukas, 1997). Urban planners and urban studies scholars in particular have emphasized the potential of Geographic Information Systems (GIS) and remote sensing to better understand and manage the rapid changes that characterize urban areas (Abbot, 2003; Baud et al, 2009; Joshi et al, 2002; Kohli, Sliuzas, Kerle, & Stein, 2012; Madon and Sahay, 2000; Madon et al, 2004). In transitional economies GIS and related technologies are being implemented especially for property and land administration (Madon, Sahay, & Sahay, 2004; Harvey, 2006; Silva, 2007).

Nonetheless, students of Indian cities have shown that government can also govern *without* comprehensive information, in the form of statistics and maps. For instance, Ghertner (2010) shows that aesthetic criteria override the evidence from statistics and numbers in slum resettlement in New Delhi with the “*appearance* of filth or unruliness in and of itself ...[as] a legitimate basis for demolishing slums” (201, emphasis in original). Roy’s ethnographic studies in Calcutta (2003, 2009) show that urban governance often functions by “unmapping” cities. The absence of maps and statistics allows the state considerable flexibility to alter land use, deploy eminent domain to acquire land, and move the poor around (Roy, 2009).

Furthermore, the state/non-state dichotomy has come under closer scrutiny. Far from being a monolithic entity with one coherent interest, the state consists of a multiplicity of agencies with partially overlapping jurisdictions, with complex and emerging relations to private and research entities, and is increasingly tied into international bodies and regulations; the citizenry or “non-state” is just as incoherent (Fenster, 2006).

To unpack these complexities we need to engage with state improvement schemes encompassing a range of tactics and techniques (Li, 2005). The reason for such engagement is to explore, what effects these varied tactics and techniques have on scheme implementation (Li, 2005). Empirically, one often observes a variety of techniques of knowledge production that span across the state/non-state dichotomy, and employ various forms of technology, including individual desktop applications, paper and combinations thereof.

In this article we amplify Scott’s (1998) analytical concept of legibility in order to analyse and compare two practices of official knowledge production in the context of two government improvement schemes: GIS property mapping in Nirmala Nagara in Karnataka and slum listing in Basic Services to the Urban Poor (BUSP), in Karnataka and Maharashtra. Although these schemes have different aims, they both share the basic requirement

underlying legibility making as conceptualized by Scott, where government is expected to produce unambiguous and standardized knowledge of society and the territory. Against this underlying commonality, our study explores how legibility making handles urban realities encountered in practice, and the implications this has on scheme implementation.

In the following sub-section we conceptualize official knowledge production drawing on Scott's (1998) work and recent amplifications in anthropological research as basis for the comparative analysis. Then we describe our research methodology and the background of the two government improvement schemes. After comparing the two practices, we discuss implications of our analysis for participation in urban governance beyond specific government schemes.

4.3.2 Amplifying Scott's notion of legibility making

In "Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed" Scott analyzes a range of state-driven improvement schemes in history across the globe through the lens of legibility. Legibility making refers to processes through which the state gradually gained a handle on its population and territory. These processes are manifold, but "[i]n each case, officials took exceptionally complex, illegible, and local social practices, such as land tenure customs or naming customs, and created a standard grid whereby it could be centrally recorded and monitored" (Scott, 1998, p.2). Underlying efforts of legibility making is the notion of official knowledge, a permanent, unambiguous, standardized, and comprehensive knowledge, and as such a simplified version of reality (Carson, 2011; Scott, 1998).

Scott's example of land and cadastral maps illustrate the characteristics of legibility making. Local practices of land use and ownership are not only complex and often illegible to outsiders in terms of spatial arrangement, but also flexible through time. Land maps and particularly cadastral maps were designed to not only *standardize* the socio-spatial relations around land holdings across different localities, but also to trace land distribution and ownership through time promoting a *permanent* knowledge, for instance through the creation of last names that allowed tax authorities to track owners across generations. In its aim of assigning one piece of land to one owner, the cadastral survey emphasizes *unambiguous* knowledge, as well as *comprehensiveness* in terms of coverage of territory and types of tenure and land holdings. Because of the multiplicity and complexities of local ownership regimes, such knowledge necessarily has to bracket out certain forms of land ownership and use practices. If backed up by state force, for instance legal means, legibility making also has the power to alter the reality that it seeks to depict.

Within the framework of e-administration (Madon, 2009) large-scale, integrated information systems (IS) and infrastructure (II), including cross-organizational GIS, are closely allied with the notion of legibility making as conceptualized by Scott. The integration of administrative agencies, their systems, applications and databases require codified knowledge, and the standardization and classification of digital data (Homburg, 2008; Stalder, 2011). And conversely, increasing reliance on IT based practices also foster the notion that only standardized, codified knowledge counts as legitimate (Tsoukas, 1997). System and database integration in government also contribute to an increasingly permanent knowledge base because the politics and histories that produce classifications sink into the routines of software applications, databases and work processes (Bowker and Star, 2000). At the same time, deletions and errors once made are increasingly difficult to reverse (Prins, Broeders, & Griffioen, 2012). In this sense, e-government efforts are a historical continuation of older sociotechnical assemblages that were deployed by the state to make its society and territory legible.

In Scott's scheme, the counter-part to standardized and permanent official knowledge produced by the state is local, vernacular knowledge. Vernacular knowledge draws on individual experiences, entails learning by inhabiting a specific place and tacit forms of knowledge embedded in local history. One of the many examples Scott gives is the knowledge of local farmers accumulated through ongoing experimentation, and an intimate understanding of environmental and social relations of a particular place. Scott (1998) thus makes a basic differentiation between official knowledge that is of the state and vernacular knowledge embedded in local practices: "*Each undertaking... exemplified a **pattern of relations between local knowledge and practices on one hand and state administrative routines on the other.... In each case, local practices of measurement and landholding were "illegible" to the state in their raw form. They exhibited a diversity and intricacy that reflected a great variety of purely local, not state, interests.*** (Scott, 1998 p. 24; emphasis added).

Recent anthropological research has amplified Scott's analytical scheme by zooming into the "pattern of relations" Scott refers to. Within this body of research scholars have argued that the state cannot be conceptualized as a coherent entity with one interest and as the sole driver of improvement schemes hovering above a multitude of local complexities endowed with vernacular knowledge. According to Li (2005), multiple authorities are involved in improvement schemes, including scientists, political activists, and ethnographers creating different assemblages of interests, techniques, and discourses intertwined with the state. But in addition to this multiplicity, the idea of a state as monolithic entity with one intent and as container of power is also contested (Li, 2005). Gupta's (2006) ethnographic research of

relations between rural people and state officials in a north Indian village demonstrates how decentralized and dispersed the state is empirically, and how it is implicated in the texture of everyday life. Similarly, Ferguson and Gupta (2002) argue that the idea of a state hovering above grassroots organizations does not hold empirically. The state viewed as set of practices is also very much local in its materiality and situatedness. So called "grassroots" organizations may be global when they network across continents and countries, for instance through international slum dweller associations. The idea of the state imagined in a vertical arrangement above the local and below the global, dissipates upon closer empirical observation. Rather, the game board is made up of multiple fields of power emerging from players' various tactics and practices (Li, 2005). This means that resistance to an improvement scheme does not need to arise from "pristine spaces outside of power," i.e. outside of the state, as Scott's work may imply, but can arise from within the bureaucratic apparatus itself (Li, 2005).

Hull (2012) combines insights from Science and Technology Studies (STS) and anthropology in a detailed ethnographic account of bureaucratic practices in the planning and governance in urban Pakistan. His study of graphic artifacts and their circulation through the city of Islamabad illuminates how bureaucratic writing is not only a mechanism of state control over people, places, processes, and things, but that official knowledge production engages places and urbanites in such a way that the political function of documents is highly ambiguous. The documents, lists, and maps take on an agency of their own mediating between government and society. Although a state plan may be designed to separate the work of government from the larger social world, individual documents and files work "not only as instruments of bureaucratic control but also as media of dissent and negotiation between the government and populace" (p. 66). According to Hull (2012), scholars need to explore the practices that enact bureaucratic objects, such as lists, petition letters, maps, and planning documents in order to discover how they have been turned into allies of individuals or groups of people that cut across the state/non-state dichotomy. This is necessary also to "explain the ordinary success of bureaucratic schemes" (p. 207).

Along similar lines, Li (2005) proposes to focus on three junctures in order to amplify Scott's analytical schemes, namely (i) when local knowledge is adjusted for the purpose of the intervention, (ii) when local knowledge sustains bureaucratic and profit-making schemes, and (iii) when local knowledge and practice is embraced by experts (Li, 2005). Our comparative analysis takes the first two of these junctures as points of departure.

Scheme implementation requires "the state" to make its society and the city legible through official knowledge production. But how this takes place can

vary in practice. Zooming into the “pattern of relations,” which Scott (1998, p. 24) himself mentions, we conceptualize legibility making as practices of knowledge production within improvement schemes that *arise along a continuum* between state and non-state actors, and between official and vernacular knowledge. This amplification allows us to bring to the foreground legibility making practices that create varying entities with authority and power, and position people as members of certain groups and to explore practices that fill the gaps between official plans and on-the-ground realities (Li, 2005).

4.3.3 Our study in the context of two government schemes

We draw on empirical material from qualitative research conducted between 2008 and 2012. The research sites were three cities in the Indian state of Karnataka: Bangalore (the state’s capital), Mugdali and Dhabunagar, as well as in Kadovali³⁷, in the state of Maharashtra, complemented by interviews in Mumbai for comparative purposes in a different state. In Mugdali, Dhabunagar and Kadovali we carried out a multi-site ethnography (Crang, 2005; Hine, 2007), with data based on semi-structured interviews, field observation, and collected scheme documents (table 4.3.1, also Richter, 2011; Richter, Miscione, De’, & Pfeffer, 2011). Data collected during several fieldwork rounds was inductively analyzed and played against literature and explicit theory (Strauss and Corbin, 1994). The ethnographic methodology employed has been informed by STS insights with the aim of retaining interpretive symmetry between human and non-human actors influencing the practices under study (Czarniawska, 2007). This is reflected in the comparative analysis, where we discuss technical as well as organizational design aspects of both practices. Scott’s notion of legibility making emerged through inductive analysis as a common denominator for a comparison across two different government improvement schemes as both schemes require the government to produce knowledge of society for implementation.

Our study took place during the implementation of two major improvement schemes: the Jawaharal Nehru National Urban Renewal Mission (JNNURM) and Nirmala Nagara.

³⁷ We opted for fictitious city names in three cases (Mugdali, Dhabunagar, Kadovali) to retain anonymity, because of informal and intimate research encounters in these cities.

Table 4.3.1: Summary of Fieldwork by city and time

City & Government Scheme	Mugdali, Karnataka BSUP, Nirmala Nagara	Dhabunagar, Karnataka Nirmala Nagara	Bangalore, Karnataka BUSP, Nirmala Nagara	Kadovali, Maharashtra, BSUP	Mumbai, Maharashtra, BSUP
Fieldwork Periods:	Aug 2008, Mar-Jun & Sep -Dec 2009, Oct - Nov 2010	Aug 2008, Oct-Nov 2010	Mainly Dec 2010-Feb 2011	Apr-May 2012	Apr-May 2012
Synthesis of main fieldwork activities (besides collection of active government records):	Survey shadowing, transect walks and observation in slums, observation and interactions at slum district and municipal offices, Attendance of weekly JNNURM review meetings	Interactions and observation at municipal office, district slum office, and "poverty cell" of municipality	Semi-structured interviews with key stakeholders in Nirmala Nagara at state-level and planning consultants, attendance at Municipalika Conference	Transect walks and interviews at slum re-construction sites, observation and interactions at BSUP engineering cell, interview with head of poverty cell of municipality	Semi-structured interviews with MHADA and MMRDA officials

JNNURM, a large-scale, seven-year long national investment scheme for cities across India, was launched in 2005 to conduct major urban infrastructure development based on the condition of reforming governance to receive funding. IT played a key role in supporting systematized accounting, benchmarking, and performance measurements in the scheme. JNNURM was being implemented in Mugdali and Bangalore in Karnataka, and Kadovali in Maharashtra during fieldwork. One of the sub-missions of JNNURM was Basic Services to Urban Poor (BSUP), which sought to improve the lives of slum dwellers through housing and infrastructure provision. BSUP did not require a specific IT for data collection and management, but through the practice of "slum listing" used diverse technologies already in place to list target areas and beneficiaries.

Nirmala Nagara was launched in 2005 by the Government of Karnataka in 57 cities, including Mugdali, Dhabunagar and Bangalore, to take advantage of JNNURM's reform agenda. This scheme's main focus is the implementation of municipal e-governance systems (Ranganathan, 2012). It was initially funded by the Asian Development Bank as part of an urban infrastructure project in northern Karnataka. In 2006 the World Bank took over most of the funding and expanded the scheme to include the computerisation of the functions of all municipal corporations in Karnataka. One of the scheme's components is the 'Geographic Information System (GIS) based property tax system' (in

this paper: "GIS property mapping"). In Dhabunagar and Mugdali survey work for GIS property mapping started in 2006.

In both JNNURM (including BSUP) and Nirmala Nagara, a parastatal organization, the Karnataka Urban Infrastructure Development Finance Corporation (KUIDFC), negotiates and brokers loans, oversees reforms, and acts as disciplinarian of municipal reforms (Ranganathan, 2012). In the case of Maharashtra the Maharashtra Housing and Area Development Authority (MHADA) and Mumbai Metropolitan Region Development Authority play a similar role, with MHADA in charge of the BSUP sub-mission. The implementing agency for BSUP cities in Karnataka is the Karnataka Slum Clearance Board (KSCB), a parastatal organization, established in 1975. Monitoring work is guided by the state-level office in Bangalore. Scheme implementation and tax or installment collection from other, previous scheme beneficiaries are coordinated through the slum office at district level. In Kadovali, Maharashtra, the scheme is implemented through a BSUP Engineering cell within the municipal corporation, not through a parastatal Slum Board.

Both Nirmala Nagara and BSUP require city administration to map urban space and account for its population, i.e. to produce official knowledge of the status quo for subsequent scheme implementation and monitoring. *GIS property mapping* and *slum listing* are practices of legibility making in Nirmala Nagara and BSUP respectively to improve urban governance and residents' lives in the city.

4.3.4 Comparative Analysis of GIS Property Mapping and Slum Listing

In the following sections we identify the commonalities and differences between GIS property mapping and slum listing in terms of scheme goals and requirements, on-the-ground realities, the practices of legibility making in each case, and effects on the progress of each scheme.

4.3.4.1 Scheme goals and required legibility making

Under Nirmala Nagara, city administrators are expected to compile a GIS database of the properties within the municipal jurisdiction for all cities included in the scheme through GIS property mapping. The database is supposed to be stored on a central server in Bangalore, networked with municipalities in future, and updated at certain intervals. This is expected to provide a basis not only for tax revenue collection and monitoring, but also for strategic planning, and to provide online access to citizens with the option "to click on a polygon [one property outline] on the web and retrieve the relevant ownership information." (Department of Municipal Administration official).

Under BSUP, administrators are expected to delineate boundaries of slum areas and their respective residents along with their characteristics through slum listing. This information, in the form of paper and digital lists and tables, architectural drawings and sketch maps, is required for three main purposes in BSUP: phase-wise funding release through state nodal agencies, allocation of new housing units and monitoring of progress, including land acquisition, phase-wise building construction and subsequent housing allocation.

Despite differences in the official aims of each scheme, both share the basic tenets of legibility making as conceptualized by Scott: the government (city administration in our empirical cases) produces unambiguous, standardized knowledge of the city: properties and slums with respective owners and/or residents as well as their characteristics. As far as the schemes are concerned this knowledge would ideally be permanent providing a basis to take subsequent steps in scheme implementation and other strategic planning. Against this common requirement and assumption of legibility making by the state, the next step in our analysis takes a closer look at the urban realities encountered by both efforts in practice.

4.3.4.2 On-the-ground realities: urban settlement processes and the amorphous state

The ways of accessing, claiming, using and owning urban land are highly flexible and locality-specific. They include a wide range of semi-formal and flexible arrangements, including temporary and informal rental agreements, flexible uses of spaces by street vendors, incremental construction of shops and additional rooms and houses (Figure 4.3.1), as well as multiple ownership agreements, all of which are linked to livelihood strategies of residents.



Figure 4.3.1: Staking out space one roof at a time: incremental resident-constructed housing at Bandra Station, Mumbai (Figure source: author's own, 4th May 2012)

Different localities in the city grow from their specific histories, histories embedded in a multiplicity of land tenure regimes, driven by events and accidents, a complex web of power relations that underpin contestations over land claims by different groups of people, various means and modes of settlement, different forms of group leadership, and the interplay between local and global economy (Benjamin, 2008; Benjamin, 2008a; Benjamin et al, 2008). For our analysis, it is important to note that these settlement, land use and ownership processes are the soil nourishing the growth of an amorphous state. The state does not hover above a fluid urban landscape. Members of the state, politicians and administrators, at different hierarchical levels, are entangled in various competing interest alliances and perform different roles and identities. This is evident in GIS property mapping and slum listing.

In GIS property mapping it becomes manifest in conflicting interests between state-level officials and municipal administrators. While the Municipal Reforms Cell (MRC) and Directorate of Municipal Administration (DMA) have an interest in the completion of a permanent, cross-municipal urban property database, district and municipal administrators may be tied into processes of land claiming and related contestations that do not align with these interests. Municipal revenue officers and commissioners are associated with private developers, planning and development agencies that in turn pursue varied interests regarding a specific locality. State versus non-state interests are simultaneously personified in municipal bill collectors (street-level bureaucrats).

The amorphous state directly bears on practices of legibility making in the GIS mapping case. Often cited problems of on-the-ground surveys are “corruptive practices” by municipal bill collectors and surveyors (or both). But the term “corruption” does not always do justice to the relations between residents and street level bureaucrats. Bill collectors have longstanding personal relations with residents and neighborhood leaders. They negotiate the multiple set-ups, rental agreements and mixed uses of a locality. Livelihoods, directly related to claiming land are at stake and rely precisely on the very flexibilities, which the construction of permanent knowledge through GIS property mapping seeks to eliminate or simplify. In municipal bill collectors then, two opposing interests collide: what is informal from the perspective of GIS property mapping is a necessity to ensure continuation of various locality specific micro-economies.

Similar contradictions arise in slum listing. A district office administrator acts according to scheme requirements when he reports in weekly monitoring meetings, but may pursue different interests when negotiating terms of scheme implementation with residents, or building contractors. A slum bill

collector³⁸, who lives in a slum, is simultaneously resident and administrator embodying potentially conflicting interests in one and the same person. In slum listing, the amorphous state personified in an individual is manifested in local politicians, especially ward councilors. They are representatives of the state. At the same time they are members of families residing in neighborhood x, as well as representatives of constituencies, which may or may not coincide socio-spatially with neighborhood x.

This influences legibility making practices for slum improvement in two ways. Firstly, administrators have to rely on local politicians (as well as informal leaders and associations) to gain access to neighborhoods for surveying, and for negotiating scheme implementation with residents. Municipal and district administrators often lamented the "influence of politicians." One ward councilor in Kadovali stated that *"they [the municipal administration] cannot do anything here [slum area that he is elected representative of] without going through me. Everything goes through me. When people who live here have a complaint, it also goes through me."* Secondly, slum lists themselves become tools in contestations over resources, including land and votes. "Tampering with lists" is a constant concern. For instance, a ward councilor may inform only family members and political allies about the location for signing up on housing beneficiary lists. Housing allocation lists may also be directly instrumentalized by politicians and other leaders in order to include family and socio-political affiliates, even if they do not live in the neighborhood under question.

In both cases then, the state becomes manifest as amorphous in terms of interests vis-à-vis a locality bearing influence on individual state members' actions, including how, when, where and what is included on a block survey map or a list. Far from being a surface underneath a state apparatus, the urban space to be mapped is the very soil from which a state grows that is amorphous in the roles and interests of its members. Both cases require the government to make society legible. In both cases the amorphous state is manifest. It grows from and in correspondence with the flexibilities that characterize use and ownership of urban space. In the next analytical step, we explore how legibility making proceeds in practice in GIS property mapping and slum listing respectively.

³⁸ Municipal bill collectors collect property taxes from urban residents (not residing in slums). Slum office bill collectors work for the slum board at district level and collect installments from slum residents, for instance installments for previous housing and infrastructure schemes, in which beneficiaries have to carry part of the cost.

4.3.4.3 Differences in legibility making: designed versus organic practice

The two practices of legibility making, GIS property mapping and slum listing, differ in terms of the agencies and sites involved as well as survey techniques.

In GIS property mapping the core tenets of Scott's concept of legibility making are tightly inscribed into the organizational design and survey guidelines. Survey guidelines aim at comprehensiveness and disambiguation of property boundaries and owner assignment, as well as standardization through a state-wide block numbering system. Surveying techniques are enforced through organizational design, for instance, by attempting to keep politicians at bay from the mapping effort. A hierarchical line is set up within administration for the purpose of GIS property mapping. In Karnataka, it is coordinated and monitored by three state-level administrative agencies: the MRC, a semi-autonomous administrative body, the DMA, a state-level administrative agency, and the state-level office of the Survey of India (SoI), which provides base maps for survey work, quality checks and official approval of newly created GIS datasets. Work at municipal level is supervised by GIS specialists deputed from the DMA. GIS property mapping is based on new guidelines for surveying and numbering of properties prepared by the E-Government foundation.

The emphasis on spatial representation of properties is related to the need for comprehensiveness. The rationale behind GIS property mapping is to visualize the location of properties in relation to each other and in relation to every street as a means to ensure full geographical coverage of the municipal administrative area and to identify missing records. Spatial visualization here enables to identify "holes in coverage" by capturing so called "revenue pockets." Despite the existence of non-GIS based digital tax systems in the two cities, GIS property mapping requires the re-surveying of all streets and properties based on new guidelines. Exact delineation of each property is important, accurate assignment of each owner to respective property, and ensuring that all properties in the city are thus captured unambiguously and comprehensively. Important to this process is a standardized approach to property numbering (figure 4.3.2) in cities across the state.



Figure 4.3.2: Block map of properties prepared by GIS specialist in Mugdali, approved by SoI, and then sent back for additional validation by GIS specialist. The numbers indicate: first two digits = ward number; second digit: block number (one map sheet per block), 3-5 digit: street identification number, last three digits: property identification number. The latter are different from existing door and house numbers used by postal service, for instance. They are newly assigned according to the Nirmala Nagara GIS survey guidelines. (Source: author's own, 21 May 2009)

To ensure standardized knowledge production, the protocol for legibility making from ground survey to digital dataset validation is the same for each city and set out in detailed steps. Instructions include the order in which survey forms are to be filled out, the order in which blocks and properties are to be surveyed and numbered, assignment of staff members in charge of each step, as well as signatures required for approval according to administrative hierarchy.

Slum listing proceeds differently both in organizational terms and survey techniques. Guidelines, delineation criteria, and actors involved are less clearly prescribed than in GIS property mapping. Legibility making in this case has a more organic and ad-hoc character. Although BSUP guidelines specify Urban Local Bodies (ULBs) as implementing agency, survey work in Mugdali is handled by the district office of the KSCB. In addition, the official definition of slum is ambiguous. In Karnataka it is based on the 1973 Slum

Clearance Act and pertains mostly to physical characteristics of a slum. But there are further stipulations in terms of resident eligibility for inclusion in the scheme. These criteria, especially regarding length of stay in a place, change over time depending on different state policies. Furthermore, proof of length of stay depends on possession of other documents, for example bill payment statements and below poverty line (BPL) cards.

In Mugdali we identified three main sites of legibility making: slums themselves, the district slum board office, and JNNURM review meetings at the main municipal office. The JNNURM review meetings have been specifically set up for the purpose of progress monitoring, including BSUP. The other two sites (slums themselves, the district slum board office) are “traditional” in the sense that they existed before the JNNURM scheme. However, even the weekly review meetings rely on information collected and compiled at these traditional sites. These three sites are not “set up” for legibility making, but are more organic and characterized by a convergence of urban actors and their interests, which in turn lead to an ongoing co-construction of information at these sites. The sites constitute meeting places between the scheme’s requirements for legibility making by administration, on one hand, and the interests and strategies of multiple actors at the backstage of official knowledge production.

The survey in slums themselves (first site) takes place for purposes of declaration or for other scheme implementation steps in already declared slums. These sites are not selected according to a standard set of criteria, but are mostly areas, which have become enrolled in past schemes through formation of politico-administrative alliances in the city (see also Richter, Miscione, De’, & Pfeffer, 2011). Survey work in these “already-known-to-be slums” is carried out by bill collectors of the district slum office together with residents and neighborhood leaders (figure 4.3.3). While bill collectors record information in the official survey form, residents also keep track of the same information on their own list and check for consistency.



Figure 4.4.3: Member of “the state” is surveying *with* a member of “the non-state” in Mugdali - District slum board bill collector/surveyor and resident of a declared slum are comparing lists of homes and family names to fill out BSUP socio-economic survey forms and keep track of the same information on the resident’s list. (Source: author’s own, 22 May 2009)

The survey process in slums is rather casual. Residents invite the bill collector for tea and share latest family and neighborhood news. Filling out the official survey form serves as formal frame for informal communication and exchange of news about BSUP, but also other state schemes, beyond the immediate survey task.

A second site is the district slum office, where the survey forms are digitized in Microsoft Excel® files. This information together with various engineering details and budget calculations is passed on to a private consultant, who combines the information with an architectural layout plan into a Detailed Project Report (DPR) for each slum, a necessary pre-requisite to acquire funding through the finance nodal agency. This formal line of information construction becomes intercepted by residents and their intermediaries. The slum district office is visited daily by residents, political leaders, nongovernmental organizations, and slum dweller association members. These actors meet in and around the office, in small shops rented out to slum residents by the slum office, and the office of the Assistant Executive Engineer (AEE). In these daily meetings and informal interactions, scheme details, problems and reasons for delays are being discussed, people inquire about inclusion on beneficiary and slum lists, discuss bill payments, future

housing options, the issuance of various identity and eligibility documents, or lobby against relocation of settlements. At this site too, we see a formal line of knowledge production in the compilation of DPRs and overview tables prepared for monitoring meetings, providing a frame for informal, non-procedural interactions. The AEE especially plays a crucial role in bridging eligibility and scheme requirements with individual families' needs and situations, and at the same time negotiates the interests of labor unions, slum dweller association and other organizations and leaders, in the midst of financial transactions with building contractors and private architectural consultants.

A third site of interaction between administrators of various departments, politicians, and citizens are review meetings at the main municipal office in Mugdali. During fieldwork they took place weekly and were open to the public once per month. In every meeting a Microsoft PowerPoint® table of declared slums that are part of BSUP is displayed via projector and updated during the meeting. While the slum list is presented as final and comprehensive in the meetings, it changes weekly through updates in the slum district office, but also during the meeting depending on input from participants. The meetings are formally set up as a means for citizens to participate and agencies to coordinate progress evaluation of JNNURM. As such they take place according to agendas, guidelines on how to present progress information (e.g. the PowerPoint table format), and are marked by more formal interactions between participants.

In sum, slum listing is characterized by a greater diversity in actors, who construct information in a more ad-hoc manner depending on circumstance and across traditional sites, "traditional" in the sense that they had been involved in previous schemes (both slums and district office). GIS property mapping is designed to retain legibility making in the hands of administration, and to enforce disambiguation and standardization as far as possible through a designed practice. What is the nature of the official knowledge produced in each case and, more importantly, the effect on scheme progress?

4.3.4.4 The nature of official knowledge and scheme progress

In GIS property mapping resistance to legibility making arises from settlement and land use processes. There is a stark contrast between the need for a final and permanent database, and changes on the ground. Survey work and the detailed prescribed linear steps cannot keep up with new construction and settlement (Richter, 2011). Resistance may also stem from residents of a locality refusing entrance to surveyors, instances when police may be deployed to enforce measurements to take place. In GIS property mapping a more tacit form of resistance arises from within the state itself,

especially among municipal administrators. At the same time, survey work relies on municipal administrators' (especially bill collectors') support in navigating neighborhoods and in gaining the trust of residents. In Kadovali, Maharashtra, surveyors of a private company were allowed entrance by resident groups only after bill collectors accompanied surveyors and gave their approval. Putting in place a local DMA representative, the deputed GIS specialist, does not circumvent contradictory interests within administration. In Mugdali, for instance, the GIS specialist was transferred and replaced by a new person during the time of our research due to a "lack of progress" according to municipal officials. The new deputed specialist was not only ill-informed of the status of work, but also unfamiliar with the inner workings of the revenue department, and had difficulties establishing day-to-day relationships with bill collectors and other officials in the municipality. The lack of support incapacitated the new GIS specialist for some time. The database is thus constantly under construction with varying reports regarding the progress achieved in terms of filling digital files and tables.

Set against the aim of producing a final, permanent database, the perception of incompleteness and partiality of the produced official knowledge takes center stage. This is where a more subtle effect spins off. Scheme proponents call into question the interest associations and relations between municipal administration and other actors. It is precisely the *relations between* "citizen" and "state" (street level bureaucrats and local politicians) that impede survey work. The amorphous state stands in its own way so to speak. One mayor expressed her concern to the DMA Director as follows:

"... though we have the approval from the government of India to introduce the system, ... every now and then the manual people [surveyors/bill collectors] are doing some kind of hacking, something or another ... so, I cannot hire a third party company to check on the manual people, because ... if I have to stop the corruption I cannot tell that fellow [surveyor/bill collector] I will follow you [around]" (at a session in Municipalika conference in Bangalore).

The mayor essentially suggested the need to hire supervisors in order to monitor the work of administrators. To some degree, GIS property mapping turns into a self-referential monitoring effort; self-referential, because it monitors progress of the survey work itself and holding "part of the state" accountable for progress of survey work, namely municipal and district level administration. The MRC monitors progress of GIS property mapping using comparative maps that show the percentage of area in cities where survey work has been completed. If certain municipalities repeatedly display low levels of progress, the respective Commissioners are called for meetings to discuss causes of delays. The MRC also sends delegates to monitor progress

in municipalities. Further uses of a final and complete database for planning and online access remain future visions. In neither city was the GIS database fully implemented for tax collection and monitoring purposes at the time of fieldwork.

BSUP, on the other hand, proceeded beyond listing slums and residents towards its broader aims. Land is acquired, people relocated, houses constructed, and new tenements allocated. In slum listing, too, the amorphous state is evident in contradictory roles and interests of members of the state. This may set off a series of ripple effects during implementation of the scheme. In one area in Kadovali land ownership disputes, combined with list tampering, led to work delays, and cost escalations. While the building contractor did not agree to cover the extra costs, the state-level nodal agency had not yet decided to provide additional funds. Residents of the slum, who had been paid 18,000 rupees for renting homes elsewhere during the initially anticipated time of construction, were now severely impacted by delays as the already small amount of rent money was used up and their homes demolished. These problems in turn became known to residents of other areas, who now sought the opposite, namely to be removed from the "beneficiary" lists. The negative effects on certain groups of people, especially those displaced, lead to a series of new reactions and counter-reactions with lists being accordingly adjusted.

The unpredictability in the course of events makes it sheerly impossible to keep a comprehensive, unambiguous, let alone permanent list of slums and beneficiaries even within one scheme like BSUP. Not only that, because information construction itself is a tool in contestations, a strategic means to claim land, housing, municipal services, and make money there are clearly interests in retaining multiplicity and ambiguity, but these interests cannot be assigned to any particular homogenous group of actors, nor are they stable through time.

Although the knowledge produced through slum listing is temporary and incomplete it counts as official knowledge at certain points in time, for instance during review meetings. As such it keeps the scheme moving incrementally: for stepwise funding release, for each review meeting, for every visit to the city by a monitoring team, for allocation of units in houses that have been constructed, and so forth. Final reports and official tables submitted for review and monitoring are already partially outdated once they are submitted. While a DPR is being approved by state-level review commissions, those included in the beneficiary list no longer see the scheme as beneficial and the lists are already being contested across the city. But the official reports presented and submitted at each step, in review meetings and commissions, evoke the appearance of a permanent representation of the

city's slums and residents. This temporary legibility is just-enough-legibility to keep moving incrementally or as one DC put it.

*"Actually there is no slum as such. The city is very diverse and the so called slums themselves are very heterogeneous. But **sometimes** you just have to put things **black and white** in order to keep moving."*

Some of the multiple lists and maps come to represent a *temporarily 'official'* knowledge, actually a snapshot of a given situation, the documentation of a temporary alignment or a compromise of colliding interests. This temporarily official knowledge allows administrators to adjust to the volatility and fluidity of urban settlement and land use processes and thus accommodates the ground-reality of an amorphous state as expressed by two MHADA officials:

Planning, implementation and monitoring follow a strategy of situation-by-situation adjustments, every time matching information and action, to new ground realities.

Temporary legibility making in BSUP sustains the improvement scheme in so far as it allows the scheme to progress towards its broader aims. But the original points of reference in form of permanent official knowledge are no longer valid, which also means that temporary nature of knowledge defies comprehensive and "objective" evaluation across time.

In 4.3.2 two we have summarized the comparative analysis in from previous sub-sections. In the following we discuss implications for urban governance in more detail before closing with notes on future research and policy.

Table 4.3.2: Summary of comparative analysis between GIS property mapping in Nirmala Nagara scheme and slum listing in BSUP and theoretical and governance implications.

	GIS Property Mapping in Nirmala Nagara	Slum Listing in BSUP
Scheme Goals	Increase and monitor municipal property tax revenue	Improve lives of slum residents through provision of physical infrastructure/housing
Core requirement for scheme implementation = legibility making as per Scott's conceptualization	<i>The state produces official knowledge of the city (residents & land):</i> <ul style="list-style-type: none"> - Standardized, unambiguous, permanent knowledge is in the interest of the state and produced by the same - Residents and land form stable surface to be made legible 	
	Administration delineates properties, characteristics, and each owner	Administration delineates slum, its residents, and characteristics
Urban reality encountered during implementation	Amorphous state manifest in both cases: <ul style="list-style-type: none"> - entanglement of state actors in settlement processes, not hovering above still life of the city - incoherent intent - varying roles of individuals depending on interest alliance 	
Practices of legibility making	Designed practice to retain core requirement and circumvent amorphous state: <ul style="list-style-type: none"> • Sets up organizational line according to administrative hierarchy for purpose of legibility making • Follows strict protocol for information processing and validation according to administrative hierarchy • Deploys survey guidelines according to standard block and numbering system 	Organic practice carried out by an amorphous state: <ul style="list-style-type: none"> • Legibility making at "traditional" sites with history of involvement in similar schemes • Without strict protocol for information processing across hierarchy and places • Draws on ambiguous and changing criteria over time to delineate slums and residents
Nature of official knowledge and effects on further scheme implementation	<i>Incomplete official knowledge</i> induces self-referential monitoring efforts and municipal/district administration held accountable for survey progress	<i>Temporary official knowledge</i> allows scheme to proceed to relocation, construction of houses, allocation of new units
Relevance for theory	<ul style="list-style-type: none"> - Further supports Scott (1998) in terms of resistance to achieving full legibility - amplifies Scott, because resistance arises from within administration in its relation to other actors and land 	<ul style="list-style-type: none"> - illustrates a juncture where improvement scheme is sustained locally (Li, 2005), specifically through temporary legibility - metis enacted through an amorphous state
Implications for urban governance	Indicates tendency towards separation between administration and broader society: question of who can access official knowledge production	Objective evaluation, whether scheme improves lives of the urban poor or even in terms of eligibility criteria is questionable, but retains channels for negotiation important especially for poorer groups in the city

4.3.5 Case interpretation within the broader frame of urban governance

In both schemes, the underlying requirements for official knowledge production are in line with Scott's analytical concept of legibility making. When zooming into the pattern of relations between the two analytical poles (state/official knowledge and local/vernacular knowledge) as they play out in practice, we find that GIS property mapping and slum listing handle the amorphous state differently and with different effects on scheme implementation.

The scope of this paper does not allow us to discuss, in how far the provision of housing, infrastructure and related relocations really mean an improvement in the lives of the urban poor. This remains highly questionable. However within the framework of official scheme aims, slum listing supports scheme implementation in terms of construction, housing allocation, etc. in a more or less stop-and-go fashion. As such it goes beyond producing official knowledge as basis for implementation and proceeds with the latter. In slum listing administrators together with non-governmental actors deploy what Scott refers to as *metis*. *Metis* in practice is a means of comparing forms of knowledge embedded in local experience with the more general, abstract knowledge deployed by the state and its technical agencies. What is essential to *metis* is knowing, how and when to apply the rules of thumb or categories in a concrete situation. Practicing and experiencing *metis* is almost always local, but it draws on and feeds back into general rules and concepts as they are applied and adjusted to a given situation.

The three sites in our study constitute spaces, where the categories "slum" and "beneficiary," that is a general, abstract knowledge required for scheme continuation, is compared to and "adapted to constantly shifting situation[s] to understand, and hence outwit, ... adversaries" (Scott, 1998, p. 313). "Outwitting of adversaries" may apply as much to a local politician outwitting the local bureaucrat through list tampering as to a resident, who negotiates inclusion in beneficiary lists with an administrator at the slum district office. In other words, *metis* in the case of slum listing becomes enacted through and by an amorphous state, not only by "non-state local" actors. It is a means to produce temporarily official knowledge through negotiation and contestation among state and non-state interests, not necessarily only state representatives. In the process official enumeration and survey techniques serve as front stage activities around which more informal, ambiguous and contested modes of interaction take place. This in turn allows municipal and district administrators and politicians to translate between the scheme's requirements for unambiguous and permanent knowledge, on one hand, and the vernacular knowledge driving interest alliances and interactions. In so far as the scheme proceeds to housing construction and allocation, slum listing

thus forms one of the junctures at which complexity and local knowledge sustain a bureaucratic scheme that would otherwise collapse (Li, 2005, p. 388).

On the other hand, GIS property mapping appears to run into much the same troubles, which British rulers and Indian administrators had run into when they attempted to number houses for tax collection and Census taking, efforts about which an "official gloomily commented [they] 'will never go far'" (Harris and Lewis, 2012, p. 658). Li (2005) notes that Scott's warnings of governing at a distance have long been recognized by agencies like the World Bank, who rely on ethnographers to identify local social and power relations in order to ensure implementation of improvement schemes on the ground. Nevertheless, it is the notion of governing at a distance which becomes translated into practice through organizational and technical design in GIS property mapping. As such GIS property mapping is akin to previous documentary regimes instituted by administration, for instance colonial powers, with the intent to constitute a more clear-cut separation between the workings of government and the larger social world (Hull, 2012). And much like earlier efforts GIS property mapping becomes undermined by the ambiguities and flexibilities that characterize the state/non-state boundary in urban governance.

In the case of Nirmala Nagara, the frustrations met in this endeavour led to a focus on the incompleteness of knowledge produced. Because the database is supposed to be final and permanent, the lack of progress in survey work itself becomes a central concern besides or even more so than actual tax revenue and monitoring. But if completeness in official knowledge was attained with subsequent online access to the information for citizens as hoped for by scheme proponents, this would not necessarily mean greater transparency of government towards citizens, a problem noted by other researchers like Raman (2012). Especially for poor and marginalized members of the urban populace it is important to access the processes of spatial information production rather than the information itself (Raman, 2012), because current practices of claiming and securing one's land require human mediation and multiple forms of documentation.

The practice of slum listing affords this openness to knowledge production to some degree. Criteria to define slums are partially constituted through program, policy, and legal discourse, but they are constantly readjusted and filled with new meaning during implementation by various state and non-state interests and actors. This stop-and-go implementation and adjustment of official knowledge according to a given situation in turn affords what Scott suggested be built into improvement schemes, namely reversibility. Slum listing allows for incremental advancement, because it merely provides

momentary snapshots of official knowledge required to proceed, but also possibly to contest later on. Incremental progress is not necessarily linear, but may go in the reverse direction depending on what interest alliances emerge and are influenced by sudden events. Were those included in the beneficiary list objectively eligible or were they members of a politician's family from a different area? Are those, who now receive new housing units still the same people, who were on the list submitted for funding approval? These questions clearly problematize slum listing practice from the point of view of "objective evaluation" within one specific scheme. Slum listing then also provides ample opportunities to "move the poor around." However, this in-built reversibility also allows residents to resist being "beneficiaries" when negative impacts become apparent during scheme implementation. For this to be possible, access to channels of negotiation are pertinent. These are retained in slum listing as it adapts to the amorphous nature of the state, where actors involved cannot be assigned to one mode of operation or area of concern, but are often involved in different, and at times contradictory, networks of urbanization (van Dijk, 2011). Slum listing is part of practices more broadly, which allow different interest groups to lobby and exchange information, and to negotiate through what Benjamin calls "quiet strategies" or "stealth-like" politics (2008, 2008a). These stealth-like modes of participation are especially important for low income groups, who have to rely on local politicians and other mediators to address administration with grievances, concerns and for municipal service provision (Baud and Nainan, 2008). In our empirical case, slums, district slum office, and municipal office are "traditional sites" in the sense that they are nodal points of communication also for other improvement schemes, and to negotiate service provision in general. Besides slums, the "offices of the various government bureaucracies themselves [serve] as sites where important information about the state [is] exchanged and opinion about policies and officials forged" (Gupta, 2006; 214). Retaining these nodal points of communication is important, because the practices enacted at these junctions allow urban governance actors to adjust to "governmental interventions [that] routinely produce effects that are contradictory, even perverse [and where] the messiness of the world, its intractability to government, is caused, in part at least, by the overlapping of various governmental programs in historical sequence or, concurrently, one program at cross-purposes with another" (Li, 2007, p.19).

Who loses and who gains at a given point in time is highly situation specific. However, the practice of slum listing allows different urban actors to enter the sphere of administrative work across various improvement schemes, agencies and departments, and related knowledge production through time and as official program frames and guidelines change.

4.3.6 Final notes for future research and policy

In 2012, Rajiv Awas Yojana (RAY), a new slum improvement scheme was initiated by the central Indian government. The scheme requires that information about slums and residents be collected and maintained in a GIS database. Although the eventual goals of the schemes, in which GIS property mapping and slum listing are to produce official knowledge differ, the amorphous state as explored in our study bears influence on both practices. Future research may address in how far RAY will run into similar problems and self-referential monitoring as indicated for the case of GIS property mapping. Alternatively, studies exploring GIS mapping in the case of slum improvement may find the eradication of some characteristics of the slum listing practice. These features include the kind of "[p]aper politics [that] may be relatively inclusive when compared to e-governance. The very cumbersome paper processes condemned by transparency advocates require much wider participation in bureaucratic affairs, though [not suggesting that] this participation is legal, just, or democratic" (Hull, 2012, p. 255).

Future research can inform policies for IT implementation by taking into account the context of institutionalization of IT not only in terms of the obstacles a context poses. Rather the difficult question to tackle is, how and which IT to deploy in order to support societal improvement without eradicating positive aspects embedded in the opaque and complex processes of paper work. A second longer term endeavor can entail the study of broader shifts in state-society relations that may arise from processes of digitalization and information centralization, shifts that may follow unanticipated and potentially unpredictable avenues.

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PART III: Synthesis & Future Directions

5. **Synthesis, discussion and conclusion**

My study within the integrated NWO-Wotro research program is the only ethnographic attempt to-date to critically reflect on Spatial Data Infrastructure (SDI) development in dialogue with non-SDI based practices in Indian cities, and hopefully not the last. The recently launched Rajiv Awas Yojana (RAY) urban government program for GIS data management of slums in urban areas—a program typifying the continuing emphasis on neo-liberal reforms, urban renewal, and administrative decentralization efforts in India—as well as the recent National GIS initiative will give further impetus to this kind of analysis. Before synthesizing the published papers and discussing possible implications of SDI development in urban governance in Karnataka, I recapitulate the main moves—empirical and conceptual—of my research journey.

Over extended periods of fieldwork in India I eventually found several aspects to be empirically salient. While the core tenets of the universal SDI concept are reflected in the Indian National SDI discourse, it is the implementation of GIS in administrative work and integration in GIS databases at state- and district-level offices that play a paramount role. Thus, in the urban arena of Karnataka I encountered, on the one hand, a dissipated Indian National SDI initiative, and on the other hand, a bewildering multiplicity of GIS development efforts especially for land administration, driven by national, or state-level bodies and non-governmental players. However, and despite the multiplicity in projects and timelines, aspirations to integrate and centralize property records do exist and some participants do speak of municipal SDI. At the same time, I encountered extant GIS development initiatives as islands in an urban sea of paper work. In my fieldwork, it was difficult to miss that lists and tables, on paper as well as in stand-alone desktop applications, played a more important role in routine administrative work than maps. Even major government improvement schemes were carried out to a large extent via paper and via mobile phone communication.

In sum, as I delved deeper into the empirical reality in India, I gradually came to realize that understanding SDI development in Indian urban governance necessitated a departure from the explicit Indian National SDI initiative and a shift in focus onto GIS development in cities as well as a dive into the sea of paperwork. The empirical context I encountered demanded a look *inside the SDI network* (the actors and rationales driving GIS initiatives and aspirations to integrate in an SDI), on one hand, and *outside the SDI network* (the actors and rationales positioned outside of a given GIS initiative). Section 2 detailed the characteristics of the empirical context.

The empirical moves were intertwined with various conceptual moves during my PhD journey. While I was becoming increasingly fluent in the empirical context, I was in parallel speculating about the usefulness of concepts proposed by researchers, who, are working at the interface of Information Systems and Science and Technology Studies (STS) and have drawn on various ways to conceptualize information infrastructure (II). An infrastructural inversion provided for a suitable methodological approach, specifically because of the emergent nature of SDI in the empirical context at hand, where entrenched non-SDI based practices are in place before SDI hits the ground. Infrastructural inversion brought into the picture the larger framework of Indian government improvement schemes, which are interwoven with and often driven by different classifying practices. Finally, an infrastructural inversion allowed me to draw possible implications of SDI development in urban governance. Over time, I explored and to a certain extent, refined a few of these concepts and drew on additional literature from anthropologies of the state. In section three, I made transparent how I navigated the conceptual landscape in dialogue with the empirical setting.

My journey was interspersed with four publications each marking a temporary point of closure in interpretations, each with specific audiences in mind. The publications correspond to sections 4.0 to 4.3 of the thesis; and sections 4.1 to 4.3 share the common theme of the “amorphous state.” The amorphous state poses a fundamental problem when attempting to embed SDI-based practices in urban administration and results in the requirement (for SDI development) to *discipline* the boundary between urban administration, on one hand, and urban society, on the other. Taking the amorphous state as point of departure, I will argue that SDI development is also an effort of state making. This final interpretive move allows me to address the fourth and final research aim in section 5.2, where I discuss possible implications of SDI development in urban governance. Section 5.3 provides an overall conclusion.

5.1 Synthesis: Infrastructuring in an amorphous state

The findings reported in sections 4.1 to 4.3 consist of rather detailed empirical descriptions within the respective analytical frameworks of each paper. Here, I answer the research questions in detail, but at a more abstract level with reference to the conceptual moves outlined in Part I (section 3) of the thesis. Then I summarize each answer in a text box and proceed to the next research question after a brief intermezzo. The aim behind this structure, especially the intermezzos, is to make explicit, on one hand, the relations between individual publications, and, on the other hand, to explain, how the theme of “amorphous state” emerged from interpretations across sections 4.1 to 4.3.

First research question: How does SDI development take place in the case of digital urban property database development and what are the problems encountered? (addressed in section 4.1)

To answer this question, I explored the development of what I refer to as the City Information Infrastructure (City II). Two closely related paradoxes characterize SDI development and at the same time circumscribe the problem space encountered in the case of the City II. In the following paragraphs I will elaborate on each paradox in more detail.

First paradox: The City II consists of three partially linked projects: the development of a municipal tax management information system (tax MIS), of a state-wide property GIS (under Nirmala Nagara) for municipalities, and of the City Survey at district level with its own survey boundary extending beyond municipal boundaries. There are future intentions to integrate these three systems into one centralised data repository at state-level and connect them to individual municipalities in an information infrastructure of sorts. Integration requires the standardization of tax collection processes, of digital representations of property ownership, and of database structures. Tensions to infrastructure arise because of the multiplicity of projects to map urban properties and record ownership information, with each of the projects having different starting and end times and involving different administrative and non-governmental agencies.

Partially, the proliferation in projects to develop digital property databases can be explained by inter-agency competition over available funding and over who gets to maintain the final database, because control over data also increases an agency's influence in urban governance processes, for instance when agencies compete over data-intensive tenders for the planning and design of new urban government improvement schemes.

Another reason is that each individual project started with a slightly distinct objective: to increase tax revenue (tax MIS), to standardize property recording at state-level for taxation and revenue monitoring purposes (property GIS), and to computerise and map legal land ownership records (City Survey). Accordingly, different survey techniques as well as different agencies became enrolled at different times. For example, for digitalization in GIS and approval of block- street-property numbering scheme, the Survey of India is involved in the property GIS development under Nirmala Nagara, but not in the tax MIS survey or City Survey.

Despite these different objectives, timelines and agencies involved, a rationale can be identified underlying the introduction of new survey techniques across projects. Each new technique seeks to increase

standardization, comprehensiveness, and accuracy of property information and recording. While the tax MIS seeks to accomplish this within the cities through computerization of property records and tax collection procedure in digital database tables, standardization in Nirmala Nagara is further emphasized through a state-wide uniform block numbering system and the promise to increase comprehensive coverage through GIS-based spatial visualization. The City Survey relies on the use of GPS technology to record property boundaries and as such further emphasizes both accuracy and standardization via reference to a global standard coordinate system. The City Survey project also seeks to unambiguously classify land use and ownership types.

The ensuing multiplicity in database structures and data formats obviously entails problems for future integration. This is the first paradox: While standardization and accuracy would be expected to support integration of databases in the long-run, the continuous chasing after new and improved survey techniques in the City II in combination with short timelines and new agencies involved in the process, endangers future integration. The rationale to increase standardization, comprehensiveness, and accuracy comes to stand in the way of integration in the long-run. *This paradox arises from within the SDI network, the City II, itself.*

Again and again the hope comes to rest on new technologies and techniques to increase standardization, comprehensiveness and accuracy of property information in order to render the highly complex and fluid landscape of urban property ownership and taxation (Li, 2007) technical, manageable and governable by urban administration. The more standardization, comprehensiveness, and accuracy a survey technique promises, the more it is perceived to accomplish the feat of moving the unstructured problem of land administration into a structured problem (Hoppe, 2011). Each survey technique, no matter how sophisticated, is underpinned by the tacit assumption that urban social space is categorizable and stable. This assumption stands in stark contrast to the existing flexibility and multiplicity of processes through which land and built environment are claimed, used, and owned.

Second Paradox: This paradox, also posing a problem in the development of the City II, arises where rationales and actors inside the SDI network meet the urban sea of paperwork. Each new technique still has to rely on the processes and records it seeks to eliminate. Through deployment of GPS technology we may get coordinate readings of property boundaries, but the issue becomes tricky when filling out the attribute table for each property polygon with respective ownership or land use information. This requires reference to exactly that which is to be eliminated: a multiplicity of paper

records through which property and land are being claimed. Competing and multiple records pertaining to land claims are held by different state institutions, as Raman (2012) points out. Each of these “may not reveal all the claims to a particular plot of land. Citizens record their claims to land in different institutions and in different registers of the State. In this respect, the databases maintained by a particular department are far from complete or continuous.”

But this multiplicity of records is tightly woven into the processes by which people claim, use, and own land and not only an outcome of different government departments involved or changing policies and laws pertaining to land and property administration. “Moreover, claims to territory and land are established in several ways including drawing on culture and symbolism (Fox 1998; Benjamin 2012, Srinivas 2005) which are not captured by official records” (Raman, 2012). The moment of surveying (whether this is guided by a block map for later digitalization or via GPS) and the population of the database with ownership information is therefore an endeavour that can be contested by different actors drawing on various sources of evidence. Some people, especially marginalized members of the urban and semi-urban population, may lose rights to land, which they previously held through traditional forms of land claims. For instance, in the City Survey land is being categorized as “wasteland” for future development. For the case of (rural) Bhoomi Benjamin, Raman, & Rajan (2007) provide evidence that categorising land into “wasteland” in the database ignores the function of such land for poorer groups, who cultivate it. In urban areas, this may affect the many areas and people, who rely on proxy documents and socio-political associations to use urban space for commercial and/or residential purposes. For example, in both Mugdali and Dhabunagar the classification of urban space as “illegal” constructions in the tax MIS database supported drives to demolish (semi-permanent) constructions, including roadside shops and residential shelters. On the other hand, people in a position to access survey work and digital database development, for instance through relations with municipal-level politicians and administrators, can use their influence to lay claim to land and property, which they previously hold rights to.

The at first sight technical issue of constructing land and property polygons through various survey techniques and filling in the GIS table columns with ownership information is in actuality a process during which the “disjunction between database (as technical storage medium) and policy (as a way of acting in the world)” dissolves, a process during which the “production of the database is productive of the new world we are creating” (Bowker, 2000a, p. 676). Depending on who loses or gains, resistance to this process arises also from within the government, because both members of administration and politicians are not neutral observers of either the flexible, multiple existing

forms of claiming and using urban space, or of the process of developing databases. The problem space of the City II is marked by conflicts of interest between individuals at different administrative levels with respect to computerization and its perceived impact on politico-administrative processes vis-à-vis a person's position in these processes. Bill collectors inside of administration, for example, may have longstanding personal relations with residents and neighbourhood leaders and negotiate the multiple set-ups, rental agreements and mixed uses of a locality. In many cases livelihoods, directly related to claiming land, are at stake as they rely on the very flexibilities, which the various City II projects seek to eliminate. Yet, at the same time survey work relies on bill collectors' knowledge of and access to neighborhoods. Regardless of the used technique, all projects of the City II database development have to rely on existing, multiple paper records as well as on the people and interests that drive multiple and flexible processes of claiming and using urban space. Although a mostly administrative effort, SDI development in the case of the City II, struggles with divergent interests among members of administration and their associations with the "city below," that it seeks to map.

In sum, each new survey technique promises to render the realm of urban land administration technical in order to make this realm manageable and governable, approximating Foucault's (2006) and Scott's (1998) conceptualizations of government practices. However, this process entails two paradoxes. First, the rationale to increase standardization, comprehensiveness, and accuracy which underlies the introduction of new survey techniques, comes to stand in the way of future integration into one centralized database at state-level, which – according to vision – would be a basis serving the multiple purposes of property taxation and monitoring, legal tenure administration, as well as strategic urban land use and infrastructure planning. Second, each new survey technique introduced still has to rely on the processes (records as well as people and interests), which it seeks to eliminate. Where participants of Ribes & Finholt's (2009) e-infrastructure are caught in tensions between the demands of the present and those for the future, the City II is in a different paradoxical situation: technology implementation struggles most with the very ambiguity and flexibility that it seeks to overcome.

In combination these two closely related paradoxes explain why current SDI development is caught in the long-now of infrastructuring, or more concretely for the case of the City II, in the continuous effort to (re-) populate digital databases before reaching the vision of large-scale integration across databases and the difficulties to embed the use of the database(s) in processes of property taxation processes, administration of land ownership and use, and longer-term planning.

Summary for research question 1: How does SDI development take place in the case of digital urban property database development and what are the problems encountered?

SDI development is characterized by a multiplicity of initiatives to map and record urban property ownership arising from:

- a) competition among participants over funding and database maintenance
- b) each project's different objectives and involvement of different administrative and non-governmental agencies.

A common rationale underlying individual projects and the introduction of new survey techniques in each is the aim to render technical the realm of urban property administration by increasing standardization, comprehensiveness and accuracy of urban property information. This is where two paradoxes arise which pose the main problems in the development of the City II:

- a) Paradox 1 arises within the SDI network: Increasing standardization, comprehensiveness, and accuracy hamper long-term integration into one centralized database.
- b) Paradox 2 arises along the boundary of the SDI network in relation to the outside of the network: Each new survey technique still has to rely on the flexibilities and ambiguity of space claim and use processes (in terms of records and people inside and outside of administration), which the new technique seeks to eliminate.

Text box 5.1.1: Summary of the answer to research question 1

Intermezzo: Before answering the second research question a few introductory remarks are in order. Information construction, exchange, and use in the process of slum declaration in Indian cities shape up in a veritable sea of paperwork, and offer an opportunity to study classifying practices, not yet informed by the core tenets of SDI. The focus on *slums* (slum declaration and slum listing) provided analytical and empirical coherence. Analytically, the term "slum" served as entry point into the empirical realm of paper records and served as a red thread through fieldwork and interpretation, for instance to narrow down, which actors to follow and which sites in the city to visit. Nevertheless, these traces connect in manifold ways with property ownership and land claim making records. "Slum" paper records and "land" paper records are deeply intertwined. For example, eligibility criteria for a slum improvement scheme require proof of length of stay. In turn, this proof of stay is itself a way of claiming urban space within the context of slum declaration and improvement. Land ownership records also come into play at a larger scale for selection of plots for relocation of slums. Related ownership contestations may arise between private owners laying claim to land, but also within government as it may be unclear whether, for example the land is owned by national or state-level government or the urban local body. The most important issues discussed in BSUP review meetings, for instance, were the funds already spent and remaining for the construction of new housing and infrastructure, quality criteria and checks from an engineering perspective (such as the quality of building materials), how to get the consent from the "beneficiaries" of the scheme and negotiate relocations of different groups of people, but also the constant dilemma of clarifying what land was available, who owned the land, and what letters needed to be

written to whom in order to either clarify ownership or to contest claims that were already being made to a given plot.

Second research question: What characterizes classifying practices in the case of slum declaration and in how far do these match the core tenets of SDI or not? (addressed in detail in section 4.2)

The core tenets of SDI, which I distilled from a review of Indian NSDI documents, are in line with the universal core tenets of SDI elaborated in the introduction of this thesis. By comparing classifying practice to what SDI would expect according to its core tenets, section 4.2 takes a look *towards* SDI from the outside of an evolving network. As such this section follows the classical anthropological tradition of making "strange" (Li, 2007) something that is otherwise assumed to be taken for granted, in this case the expectations and rationales underlying SDI development by taking on the perspective of the Other, the view from the outside of the network (Star, 1999).

A focus on classifying practice as relevant to both SDI development and slum declaration allowed for a comparison between current practice and SDI expectations in terms of actors and rationales involved despite the lack of GIS use in the slum declaration process. The procedure of slum declaration matches the core tenets of SDI. Based on standard criteria postulated in the Karnataka Slum Clearance Act, slum listing aims to comprehensively classify the city into slum and non-slum, and the residents into slum or non-slum residents. Procedure dictates that classifying slums is to be carried out by municipal- and district-level administration. Administrators are supposed to collect, verify, and integrate information about slums across the whole city in lists and tables, and include them in reports and planning documents. In other words, following procedure, current slum listing could be transferred into a GIS maintained in a municipal- or district-level administrative office. Matching the expectations for SDI, slum declaration procedure assumes the administrative apparatus to hover above the city. Administration would classify slums and residents according to a classificatory logic, where a set of formal and standard (across the city and state) criteria to define both slums and slum residents and integrate such information in comprehensive documents.

However, in reality, slum declaration is characterized by multiple, contested, and changing lists of slums and slum residents. This is due to prevalent forces at work other than the standard criteria and official guidelines set forth in procedure. The multiplicity of lists and related declaration documents that circulate among urban actors become plausible only when we take into consideration that in practice the classificatory logic presumably enacted through administration intermingles with a non-classificatory logic that is

driven by shifting socio-political alliances and relations between people, land, and built environment. Classifying the city into slum and non-slum, and its residents into slum- and non-slum residents is not only driven by standard formal classification criteria. Standard classification and formal procedure become adjusted and morphed through the influence of actors inside as well as outside of administration, the latter including residents of slums themselves, various intermediaries, NGO members, funding agencies and slum organizations. How slums come to be known to administrators at district level or in public review meetings is influenced by both the associations between different actors as well as varying interests. Within government, politicians participate in listing. Outside of government, various forms of local leadership, more or less formal non-governmental organizations such as labor unions and slum dweller federations, individual residents, and so forth, actively participate in writing lists by visiting and lobbying in and around the offices of administration, and compiling own (replica) lists that feed into official slum surveys.

Classifying practice in the case of slum declaration falls along the boundary between procedural aspects driven by the notion of formal, standard classification produced in and steered by administration, and the situational, informal work of classifying that does not seek to order through representation according to specific definitions or criteria, but rather is driven by changing and situation-dependent objectives and alliances. The latter functions in part on the basis of inconsistency and heterogeneity. In turn non-classificatory listings outside public administration merge into the classificatory listings (and vice versa), forming a dynamic dialogue from which lists emerge that cannot completely fulfil their promise of comprehensively representing the world in terms of (non) slums and (non)slum residents across the city.

At a given point in time, looking at a list of declared slums, presented as the official list, is akin to looking at a mushroom without digging further underneath to understand how and why it grew. Beyond the formal classification criteria one finds an extensive mycorrhizae-like (Engestroem, 2006) network of urban human and non-human actors. To briefly illustrate the complexities of these people-paper-place associations (which Hull, 2012, refers to as a "paper infrastructure"), it is necessary to choose one path to trace starting with official slum criteria in Mugdali. The inclusion on the slum list as per procedure is based on the 1973 Slum Clearance Act. This definition pertains to physical characteristics mostly. However, there are further formal criteria that establish eligibility of residents to be included in a given slum improvement scheme, especially the length of stay of residents, and residents' income as well as material belongings. These latter criteria change through time depending on different government policies. These criteria

influence the declaration process. Evidence of income requires possession of below poverty line (BPL) cards. These documents are issued via a BPL survey conducted at times, based on criteria, and involving municipal and district departments that differ from those of slum scheme surveys. Acquiring a BPL card requires possession of identity documents. Various semi-legal documents may serve as proof of occupancy and length of stay: official letters addressed to the family, tax receipts and electricity bills (Bannerjee, 2002). To further complicate matters, BPL cards, voter lists, electricity bills and so forth are not necessarily issued according to administrative procedure by a designated bureaucrat behind his desk. Records are also strategically constructed and employed by different non-administrative actors in the city. The documents, that form invisible threads underneath any momentarily visible (e.g. in a public review meeting) list of slums, function as forms of "paper tokens" (Tarlo, 2003). For instance documents, such as identity cards, are "issued" and exchanged between slum residents and politicians in return for votes, money or (promised) protection against eviction and need not be formally issued by administration.

Summary of the answer to research question 2: What characterizes classifying practices in the case of slum declaration and in how far do these match the core tenets of SDI or not?

The process of slum declaration is characterized by a multiplicity of slum and residents lists. This can be explained by the intermingling of classificatory listing as per administrative procedure and non-classificatory listings that do not take place according to administrative procedure.

Despite the lack of GIS use, procedural aspects of classifying practice match core tenets of SDI: Administration lists slums and residents according to a set of formal and standard classification criteria, and comprehensively across the whole city.

But classifying practice is also carried out by non-administrative actors and interests and situated within broader paper-people-place associations that stretch beyond the process of slum declaration.

Text box 5.1.2: Summary of the answer to research question 2

Intermezzo: Thus, in section 4.2 we again encounter a theme that already emerged in the interpretations underlying section 4.1, namely the co-construction of information by both administrative and non-administrative actors. This intermingling of administration and non-administration intercepts the procedure of slum declaration and in the City II forms a kind of tacit resistance to SDI development. The city does not lie still, passively waiting to be surveyed or classified by an administrative apparatus hovering above the city. Rather existing ways of recording property that the City II relies on as well as classifying practice in slum declaration take place, indeed are constitutive of, a blurred space between urban administration and urban society, a space where alliances among various urban actors blur the line between these two analytical poles (administration versus city) both in terms

of interests as well as in terms of the formal organizational membership of a person. A municipal level administrator, for instance, may act in one instance in his role as administrator, but in another in his role as member of a certain caste or as a family member depending on interests and his/her associations within a larger environment of people-paper-place associations.

In section 4.3 and with reference to Scott (1998) I gave this theme the label "amorphous state." Through this term I sought to make explicit that urban administration does not hover above urban society, and as a separate entity from the city. Rather the "line" between is a murky, difficult to delineate and highly dynamic space, inhabited and constituted by the interactions between "the state" and "its society." The sea of paperwork mediates this space. As Hull (2012) writes the "circulation of graphic artifacts creates associations among people that are often different from formal organizational structures [e.g. municipal administration and procedure] and draw people from outside the bureaucracy into bureaucratic practices." By using the term amorphous state I seek to emphasize that the paperwork also draws people from inside the bureaucracy into the practices of claiming, owning, and using urban space and land, that is: into urban society. The reason for emphasizing this flip-side of the coin derives from the framework set out for this study and my interpretive moves beginning from the inside of the SDI network towards its outside. SDI development implicitly rests on the assumption that there are formally circumscribed administrative departments, which would share data with each other and integrate by social and technical means. Hull (2012) also uses the term "porous bureaucracy." The label amorphous state in the context of my study also derives from the analytical point of reference drawing on Scott's (1998) work. Coming from this perspective the label not only refers to the fragmented nature and multiplicity of records dispersed across administrative departments, but also emphasizes the entanglement of administrative personnel and interests in existing practices of claiming and delineating urban space.

"Amorphous state:" an emergent theme across section 4

The theme of an amorphous state labeled as such in section 4.3 finds reinforcement in previous sections as reflected in the following quotes:

- From section 4.1: "[T]echnology implementation struggles most with the very ambiguity and flexibility that it seeks to overcome."
- From section 4.2: "Nonclassificatory listings outside public administration merge into the classificatory listings (and vice versa), forming a dynamic dialogue from which lists emerge that cannot completely fulfill their promise of comprehensively representing the world (all slums and characteristics in Muggali)."

Text box 5.1.3: Reinforcements of the emergent theme of the amorphous state in sections 4.1 and 4.2

The interactions between Scott's (1998) two analytical poles, "the state" and "its society," which are constitutive of an amorphous state help to explain, why both City II and slum listing are caught in a long-now of infrastructuring. Digital property databases are forever waiting to be completed. Slum lists remain multiple and continuously rewritten. And yet, the city is changing, people move, houses and roads are being constructed and large government improvement schemes are being implemented. This brings me to the next research question.

Third research question: how do SDI-based versus non-SDI based practices of legibility making work out in reaching the aims of their respective government improvement schemes? (addressed in section 4.3)

In section 4.3, I interpreted SDI-based practices using only the case of GIS property mapping in Nirmala Nagara to reduce the complexity of different objectives and actors introduced through other projects in the City II and to focus in more detail on organizational design and survey techniques in GIS property mapping for taxation. Similarly, I interpreted non-SDI based practices (namely slum listing) using the case of BSUP only as this scheme dominated the empirical scene of slum declaration during my fieldwork.

Both SDI-based and non-SDI based practices seek to "render technical" their specific domains of governance (taxation and slum-centric poverty alleviation, respectively) through organizational means and survey techniques to represent "the domain to be governed as an intelligible field with specifiable limits and particular characteristics ... defining boundaries, rendering that within them visible, assembling information about that which is included and devising techniques to mobilize the forces and entities thus revealed" (Rose, 1999, p. 33). In other words, within the framework of an individual government improvement scheme the requirement for the state to *make legible* its territory and society underpins both GIS property mapping and slum listing. Both also encounter the "amorphous state." The important difference between SDI-based and non-SDI based practices is how tightly each practice inscribes this requirement into knowledge production in terms of organizational means and survey techniques deployed. What becomes evident here is that each practice handles the amorphous state differently. GIS property mapping seeks to circumvent the amorphous state as it poses a force of resistance to property mapping. Slum listing works through and enacts the amorphous state.

SDI-based practice: In GIS property mapping, the legibility requirement is tightly inscribed into survey techniques to produce standardized, unambiguous, comprehensive, accurate, and eventually permanent knowledge. The legibility requirement is also tightly inscribed into

organizational design in the attempt to firmly vest database development and maintenance in the hands of the administrative apparatus. Resistance to GIS property mapping arises from within municipal- and district-level administration in cases where people who are formally members of administration and their interests align with urban society and existing flexible and ambiguous ways of claiming and using urban space. This slows down progress in completing the GIS property database and in turn produces a fixation on monitoring the progress of survey work itself. Broader aims of the scheme, those to be supported by official knowledge production through GIS property mapping, such as increases in tax revenue or the use of spatial data for strategic urban planning and development are – for the time being – side-tracked. What ensues is a sort of disciplining of municipal- and district-level administration by state-level agencies, which monitor the progress of survey work and indirectly the “enthusiasm” and/or compliance of individual commissioners with respect to property database development. With some exaggeration, one may say that the point of focus has shifted from counting tax revenue to counting property polygons captured in the GIS database.

Non-SDI based practice: Slum listing does not seek ever increasing standardization and accuracy by means of newly introduced survey techniques. Furthermore, slum listing takes place in a more organic fashion and follows “traditional sites” of knowledge production rather than newly designed organizational set-ups. This allows municipal and district administrators along with politicians to translate the scheme’s formal, standard classification requirements, on one hand, and the vernacular knowledge (*metis*, according to Scott, 1998) driving interest alliances and interactions, on the other. This is similar to the work done by nurses when they adjust and feed into universal health classifications as discussed in Ellingsen, Monteiro, & Munkvold’s (2007) and Meum, Monteiro, & Ellingsen’s (2011) research. *Metis* is practiced by *both* state and non-state actors and their various interests with respect to a given situation, and not only by non-state actors as Scott (1998) would have it. As such *slum listing as metis enacts and maintains the amorphous state*. The requirement of legibility making dissolves to a large degree in non-SDI based practice of listing slums, but not completely. Although slum and beneficiary lists are “relatively autonomous, weakly linked to the *process that was supposed to* [for example procedure in slum declaration] generate them ... in practice, [they are] produced by a variety of irregular activities in the murky transactional arenas of money, favors, friendship and kinship (Hull, 2012, p. 202, emphasis added), the lists also have a “powerful official presumption of truth, despite the widespread knowledge that they are routinely manipulated” (Hull, 2012, p. 203).

Time and time again a temporary list emerges (akin to mushrooms from their underlying mycorrhizae-like networks) as the official list of the moment for a given purpose at various points in time and place, for example during public review meetings or in the reports sent to state-level review commissions. This temporarily official knowledge may be outdated already once it reaches a review meeting or state-level commission, but it works in the sense that it moves scheme implementation forward. This “temporary legibility making” produces just enough legibility to proceed with relocations, housing construction, and housing allocation. Slum listing thus forms one of the junctures at which complexity and local knowledge sustain a bureaucratic scheme that would otherwise collapse (Li, 2005, p. 388) as it mingles with formal requirements for legibility. Scheme goals beyond the production of knowledge are implemented, albeit in a fragmented, stop-and-go fashion. Who benefits and in which way is difficult to identify.

In sum, both SDI- and non-SDI based practices are at first sight caught in a “forever-now” of infrastructuring, i.e. the ongoing production of official knowledge, which is envisioned to be comprehensive and permanent. But enacting the amorphous state in the case of slum listing supports scheme implementation in an ad-hoc and fragmented way. The attempts in GIS property mapping to circumvent the resistance arising from an amorphous state by tightly inscribing the legibility requirement into survey techniques and organizational set-up turns the effort into a disciplining exercise of municipal and district level administration and a monitoring of survey work rather than tax revenue.

Summary of answer to research question 3: How do SDI-based versus non-SDI based practices of legibility making work out in reaching the aims of their respective government improvement schemes?

SDI-based versus non-SDI based practices of legibility making handle the amorphous state differently.

- SDI-based practice encounters the amorphous state as a resistance and seeks to circumvent it by tightly inscribing legibility ideal into survey techniques and organizational design.
- Non-SDI based practice is a form of metis that enacts the “amorphous state,” because it does not tightly inscribe the legibility requirement into survey techniques and organizational design, but takes place more organically based on existing survey techniques and following “traditional sites” of knowledge production.

SDI-based versus non-SDI based practices of legibility making work out differently in reaching the aims of their respective improvement schemes.

- SDI-based practice side-tracks larger program aims and focusses on disciplining district-and municipal level administration and monitoring the progress of official knowledge production.
- Non-SDI based practice produces official knowledge of a temporary nature and as such supports the implementation of larger scheme goals, but in a fragmented and stop-and-go fashion.

Text box 5.1.4: Summary of the answer to research question 3

The main theme amorphous state that emerged across sections 4.1 to 4.3 indicates that the consolidation of the emergent sociotechnical network of SDI and successful production of official knowledge in Scott’s (1998) sense would require substantial shifts, in how urban governance is currently taking place, namely within and through the blurred space that spans between urban administration, on one hand, and urban society, on the other or translated to the terminology in Scott’s (1998) analytical scheme between the state and (local) society. The theme serves as point of departure for the final discussion of possible implications of SDI development in urban governance.

5.2 Discussion: possible implications of SDI development in urban governance

Future SDI development in Indian urban governance, as a form of information technology intensive legibility making, appears thus as a heroic feat. SDI development needs to create the conditions for SDI development—the separation between state and society. As Scott (1998) explains, the legibility project in Europe coincided with an era, in which the state was conceived for the first time as a force that improves the welfare of the population. “The welfare of the population came increasingly to be seen, not merely as a means to national strength, but as an end in itself. *One essential precondition* of this transformation was the discovery of society as a reified

object that was separate from the state and that could be scientifically described" (Scott, 1998, p. 91, emphasis added).

Had I followed this assumption (i.e. that society is a reified object, separate from the state) to explore SDI development in the Indian urban scene I would have to confine myself to explanations for obstacles to SDI development often rehearsed by other SDI scholars, such as: coordination is difficult, because governmental departments work in silos, or data sharing is difficult because people and organizations do not see the need to or refuse to share data, or it is difficult to map urban properties and slums, because land uses and people in the city are too diverse in India to be mapped (i.e. the legibility maker is separate from the objects to be made legible). Instead in addition to these issues - I found that *SDI development in Indian urban governance not only needs to make the city legible, and share information within urban administration, but also to create the essential preconditions for such legibility making and integration*. The precondition is the extinction of the amorphous state, or in other words, the clear delineation between the city (urban territory and people) and its administration. A clear delineation would entail the disciplining of "swaying officials" and the "policing" of the administration-city boundary through increasingly sophisticated technological means.

SDI development requires the *disciplining of "swaying officials,"* those whose loyalty to the state is required for legibility making, but who may have a stronger interest in ambiguity and flexibility despite their official role as members of urban administration. Enrolling these officials into the SDI network requires a sorting of interests (in legibility or in illegibility) and of people (the legibility makers and those who are being made legible). The success of SDI development rests at least partially on the existence of a clearly demarcated boundary between state and society, and more specifically in the context of this study, between urban administration and urban society (the city).

SDI development requires *a policing of the boundaries between urban administration and the city,* a task increasingly attempted via ever more accurate and new survey techniques and initiatives to map the city as well as organizational designs. The discourse of integration - despite general recognition of the obvious longer term tensions involved - supports the endeavor to consolidate the state vis-à-vis the society below. Thus, SDI development can be conceived of not only as infrastructure to support legibility making by the state, but also as a "state maker" - an endeavor to endow the state with coherence vis-à-vis society, a finding in accordance with Scott, Tehranian, and Mathias's (2002) diagnosis of state-making: "to follow the process of state-making, then, is to follow *the conquest of illegibility*" (p.

7, emphasis in original). In so far as SDI development entails the conquest of illegibility in Indian urban governance, it can also be interpreted as a process of state-making at the same time. This is further supported if one argues that the state itself is not so much one formally delineated organization, but constitutes and generates itself via a set of practices, one of which is the production of official knowledge. Ferguson & Gupta (2002), for instance, argue that the state is not a monolith hovering above society, but is constituted by localized and dispersed practices and techniques. From this perspective, SDI development in Indian cities may be interpreted as performing the state. The state is performed through the enactment of practices that are thought of as "typical of the modern state," such as legibility making. The Indian state, despite its sudden violent manifestations, for instance during Indira Gandhi's Emergency (Tarlo, 2003) - is also a contradictory, relatively new-born creature torn between the past and the future³⁹. In addition, India's post-colonial formation as an independent state coincides with an era when the "traditional nation state" has been dissipating across the world under the influence of neo-liberalist trends (Brenner & Theodore, 2002). Against this background, the sensitivity and defensiveness of government actors towards the infiltration of private players into the field of (spatial) knowledge production may at the same time be interpreted as a mechanism to defend the state as coherent entity itself. An article in the Hindu from April 2013 illustrates this sensitivity. According to the news item *"the Survey of India (SOI), the mapping arm of the government, filed a police complaint against Google's 'Mapathon' — the first ever mapping competition in India. It alleged that Google 'is likely to jeopardise national security interest and violate the National Map Policy.' It also threatened participants with potential breach of rules. In response, Google has stood its ground and said its activities are well within the rules. At the heart of this conflict are not legal issues as the SOI makes it out to be, but the shrinking role of the state in disseminating geographical information. Technologies have broken government monopoly over spatial data and are empowering communities to produce maps that are relevant to them. Bewildered government institutions, instead of embracing innovation and quickly adjusting to changes, are seeking the coercive power of rules to maintain dominance and stifle innovation."* (Srivathsan, The Hindu, 2013, 13 April). If legibility making is also the process of state making, declaring monopoly on the production of official knowledge does more than "stifle innovation." It also performs the state to some degree as an integrated, coherent entity, a sort-of counter-measure to international tendencies for the state to dissipate and its contradictory and dispersed nature, perhaps particularly in post-colonial settings.

³⁹ For example, in "fiction literature," Salman Rushdie's "Midnight's Children" (2008) paints a picture of this violent, yet contradictory process of state formation in India after Independence.

There is thus reason to argue that SDI development, perhaps also in the Indian NSDI, entails state-making (at least to some degree). Using this argumentation as a point of departure I address in this section the fourth and final research question.

Fourth research question: What are possible implications of SDI development in Indian urban governance, especially with respect to the role of the state and citizen participation?

Drawing on and expanding the discussion so far I will employ “the classic philosophical method of counterfactual thought experiments: to understand the significance of something [absent,] imagine its [presence,] and see what else changes” (Nagel, 2013, p. 2). This entails a move into the realm of speculations about the future (hence the word “possible implications” in research question 4). However, I will substantiate the speculations with reference to empirical material from this thesis’s previous sections and with additional fieldwork material, not included in the thesis so far. The fourth research question may be operationalized for the purpose of speculating about the future as such: *What if SDI succeeds in integrating urban administration as legibility maker, which is clearly delineated from the “rest of the city” being made legible in large-scale spatial databases?*

First, if SDI succeeds in this, conditions to hold the state accountable may improve.

A crucial victory in the state’s campaign for legibility, especially when using sophisticated technological means is integration (see section 1.2). A more integrated state is a necessary (although not sufficient) condition to hold the state accountable. Permanent and comprehensive legibility could allow for more objective monitoring of the state’s own planning activities both with respect to past decisions as well as future plans. As simplistic as it may sound, *having* comprehensive documents as basis for planning is the first step in *making them available* to the larger society. For instance, the *temporary* legibility making in BSUP sustains the improvement scheme in so far as it allows the scheme to progress towards its broader aims. But the original points of reference, which more permanent and comprehensive official knowledge would provide, are constantly outdated and lost in the process of listing and implementing the scheme. The fragmented and temporary nature of knowledge defies comprehensive and “objective” evaluation across time. Were those included in the beneficiary list objectively eligible or were they members of a politician’s family from a different area? Are the recipients of new housing units still the same people featured on the original list submitted for funding approval? These questions clearly problematize slum listing practice from the point of view of “objective evaluation”. An amorphous state operating under a lack of comprehensive documents, plans and maps allows ample opportunity to “move the poor

around” (Roy, 2009), in extreme cases, when bulldozers and police force appear unannounced for eviction drives in the name of city beautification or to make space for real estate and large-scale infrastructure development (Baviskar, 2006; Bhan, 2009; Milbert, 2006). A permanently more integrated state could also allow for better monitoring of the state’s activities in terms of both past and future decisions, not only by society at large, but also by the state itself as an episode from fieldwork illustrates.

A progress monitoring team consisting of three social workers (government appointees) had been sent from Bangalore to Mugdali to evaluate the implementation of BSUP. Hoping to gain a better overview of the process of slum listing, I set up an interview with the team. The conversation took an unexpected turn when my informants stated with some frustration that any attempts at evaluation were hampered by a lack of comprehensive and clear documentation. In turn, they asked me for help in this respect. Unfortunately I could not oblige. I had no access to comprehensive planning documents and attributed the problem to my status as a foreign researcher. I assumed that my informants would have better access to official documents, since they were government appointees and suggested that they should start with a review of all Detailed Project Reports (DPRs) for slums and follow up from there. In response, one team member shook his head replying, “Impossible. There is only one hard copy for one slum in this office, and somebody locked it away. We need an overview.” Later I met the team on several occasions in neighborhoods and slums and we continued exchanging news on our parallel endeavors. It turned out eventually, that we (a researcher and government appointees) were all busy with the same thing: tracing the logic behind slum lists by asking our way around the city. Similar to me, the evaluation team was conducting a multi-site ethnography to gain an understanding of BSUP implementation. Unfortunately, beyond exchanging information incrementally and informally when we met by chance, there was no time to compare our respective “final, comprehensive” findings.

Baviskar (2007) and Roberts (2010) report related problems in the case of applying the Rights to Information Act (RTI). India’s RTI is one of the most progressive Freedom of Information (FoI) laws in the world. The law has been widely used; and attempts by the Indian government to restrict it have failed so far due to pressure from civil society groups (Roberts, 2010). However, in an amorphous state with fragmented, multiple records and recording systems officials may evade providing the information, give mounts of irrelevant information, or outright refuse to provide the requested information (Baviskar, 2007; Roberts, 2010). How does one know, what paper to ask for if one is facing a sea of paperwork?

In sum, an integrated state producing and maintaining comprehensive official knowledge, is a pre-requisite for citizens to view information from and about the state and thus one condition to hold the state accountable.

Second, if SDI succeeds in integrating urban administration as legibility maker, which is clearly delineated from the "rest of the city" being made legible in large-scale spatial databases, conditions for the so called "floating population" may improve.

One could speculate that a consolidated state may be beneficial to some groups of people. Desai & Sanyal (2012) foreground the recognition of "smaller moves, negotiations, and alliances that form to challenge the status quo and stake claims to urban rights and resources", but the "state in India responds to these strategies again in diverse ways, from co-optation, to suppression, and tactical indifference" (p. 18) as the examples of eviction drives and responses to RTI requests illustrate. What if an administrator does not respond in diverse ways, but follows due process and acts as "administrator only" based on comprehensive, standardized, unambiguous documentation as long as he sits at his office desk? This could be of benefit in some cases. The Indian city includes a large number of people, who inhabit or rather move along the urban edges, edges not only in terms of jurisdictional or geographic boundaries, but also in terms of citizenship through access to elections as well as services. Municipal social workers or administrators involved in poverty alleviation programs often referred to these people as "floating population." The "floating population," who I met during fieldwork, was a diverse mix of migrant workers, divorced or widowed women, small groups of out-of-state (out-of-Karnataka) families, tribal or low-caste members from villages, folklorists, dancers, magicians, musicians, and various artisans, including basket makers. What they have in common is the difficulty of entering the paper-people-place associations from which an amorphous state grows and which allows space for negotiation for those people who are inside the network of associations, those who have papers. For the "floating population" the paper infrastructure is not a "seamless sub-tender of use" (to access services, voter lists and identity documents), but a barrier. It may be that a genuinely "administrative" administrator (who takes off his hat as caste member, family head, or son-in-law of a Member of Parliament) could - under some circumstances - allow people from the "floating population" to circumvent the necessity and problems entailed in accessing the urban paper-people-place associations and instead provide entry to the city on procedural grounds and comprehensive information available to him via a networked database. Some positive aspects of consolidating the state and increased legibility arise from the point of view of those, who are left out from the paper infrastructure and the benefits it entails at a given point in time and situation.

"The state is not "everywhere and always the enemy of freedom" and "can, in some circumstances, play an emancipatory role (Scott, 2012, p. xiii-xiv, emphasis in original). But what price needs to be paid for possibly improved accountability and inclusion of those left out from the existing paper infrastructure? Implications three to five discussed in the following paragraphs shed a more problematic light on potential consequences of state integration.

A third possible implication of SDI's success in integrating urban administration as legibility maker clearly delineated from the city is the increasing irreversibility of the process of implementing urban renewal and improvement schemes.

There are risks involved in replacing the paper infrastructure with a clear-cut state-society boundary and official knowledge production vested firmly in the hands of administration. One is the potential risk of losing the possibility to reverse previously chosen courses of action. Administration may "have no choice but to categorize, [and] the more any state intervenes in economic and social life, the more its classifications leave an ineradicable imprint upon it" (Starr, 1992, p. 264). However, the imprint is less ineradicable in classifying practices pertaining to slum listing and temporary legibility making (hence: this somewhat oxymoronic term) under BSUP. This is precisely because the lists are not written by the state acting as a monolithic entity, as the "master lister" so to speak. They are written by administrative and non-administrative actors. Paper records, including beneficiary lists, identity documents, etc. "participate in the enactment of bureaucratic objects, that is, of their `referents,'" for instance houses, deserving beneficiaries, and available plots for development (Hull, 2012, p. 18).

The stop-and-go implementation of BSUP and adjustment of "official knowledge" according to a given situation affords options to *reverse* the course of action, something Scott (1998) suggested to be built into improvement schemes. Slum listing in its wider world of associations between paper, places and people allows for incremental advancement, because it merely provides momentary snapshots of official knowledge required to proceed, but also to possibly contest and reverse later on. This is especially important in the case of so called improvement schemes and related identification of "target groups," if improvement turns out to be problematic during the course of implementation. According to an official with the Maharashtra Housing and Area Development Authority (MHADA), a large problem with participation during the planning stage of improvement schemes is that people often cannot imagine the impact of the scheme on their lives. They may see benefits at the beginning and give their consent to the scheme, but may later on become aware of negative impacts. This was a common occurrence in Kadovali, where people heard about problems from

other areas and lobbied with municipal engineers overseeing BSUP implementation in order to be removed from the beneficiary lists. The case illustrates that “documents ... not only work as instrument of bureaucratic control but also as media of dissent and negotiation between the government and populace” (Hull, 2012, p.67). The third implication is thus closely related to the next.

Fourth, with the success of SDI and the clear delineation of urban administration from the city, we may witness the extinction of organic forms of participation.

The often cited aim to increase participation of society in the state’s planning and development processes is (implicitly or explicitly) based on the assumption that society and state are separate entities. Otherwise, why would we ask, how a citizen can access state information, or how a member of society can request accountability of the state? Striving for a clear state-society boundary and the production of official knowledge entails the risk of deleting existing forms of participation, which more or less “organically” exist in an amorphous state. The circulation of paper records “draws people outside the bureaucracy into bureaucratic practices” (Hull, 2012, p. 18) allowing for a kind of broad-scale participation of society in governmental affairs although the possibilities for such participation and outcomes achieved are socially differentiated (Doshi, 2012; Hull, 2012).

Slum listing is part of practices, which allow different interest groups to lobby and exchange information, and to negotiate through what Benjamin (2008, 2008a) calls “quiet strategies” or “stealth-like” politics. These stealth-like modes of participation are especially important for low income groups⁴⁰, who have to rely on local politicians and other mediators to address administration with grievances, concerns and for municipal service provision (Baud & Nainan, 2008). In Mugdali, slums, district slum office, and municipal office are “traditional sites” in the sense that they are nodal points of communication also for other improvement schemes, and for the negotiation of service provision in general. Besides slums the “offices of the various government bureaucracies themselves [serve] as sites where important information about the state [is] exchanged and opinion about policies and officials forged” (Gupta, 2006; p. 214). Retaining these nodal points of communication is important, because the practices enacted at these junctions allow urban governance actors to adjust to “governmental interventions [that] routinely produce effects that are contradictory, even perverse [and where] the messiness of the world, its intractability to government, is

⁴⁰ It may be worthwhile noting here that low-income and otherwise marginalized groups, who “have to rely on mediators” are fortunate that they can rely on mediators if we look at the matter from the point of view of the “floating population” described earlier.

caused, in part at least, by the overlapping of various governmental programs in historical sequence or, concurrently, one program at cross-purposes with another" (Li, 2007, p.18-19).

Finally, the closing of spaces inhabited by and enacted through the amorphous state may have problematic effects on urban residents' livelihoods.

The amorphous state also functions as a type of social insurance. Beyond the context of improvement schemes, the forms of broad-scale participation afforded in an amorphous state are especially important in the absence of a strong welfare state. I will illustrate this through a vignette. In a northern European state, a recently unemployed person may consider setting up a coffee and bagel shop on a sidewalk. The state's representatives would probably arrive within minutes to request sales permits and point out that the particular stretch of the sidewalk is not zoned for commercial, but for residential, purposes only. Similarly, the move of homeless people into an empty, unused building in, sooner or later evokes the police to appear at the door and to eviction. An amorphous state can provide spaces (literally) for people to secure livelihoods through various coping strategies. A person, who needs to set up shop on a sidewalk in an Indian city or spread out a blanket to place fish and vegetables for sale, needs an amorphous state to survive. The amorphous state in this case may be manifest through some sort of neighborhood leader, perhaps the owner of several shops in the area, or a locally elected politician. In return for "informal" rent and fees, this person may then negotiate with the municipal tax collector or engineer in charge of the respective neighborhood to issue a proxy permit or to simply ignore the newly set up shop, perhaps again in return for a fee or in return for other favors, ... and thus spinning people-paper-place associations across the city.

Who benefits and who loses at a given point in time remains a murky business. The many ways through which associations are formed and activated, and the effects of lobbying and stealth-like politics are highly variable and elusive not only from a bird eye's view, but even to the insiders as Hull (2012) points out. However, the point here is simply to acknowledge that possibilities for different urban actors to participate in governance processes and related knowledge production exist. In combination with liberal economies and according to Scott's line of reasoning, there is a risk that state integration through SDI development, may socialize urban governance actors into losing "the habits of mutuality and cooperation that antedate it [the formal order of a liberal state]" (Scott, 2012, xxii). If one follows the argument sketched out earlier, SDI development as legibility- cum state-maker, would risk closing options of reversibility in scheme implementation and venues for negotiation.

5.3 Conclusion

The city does not lie still passively waiting to be mapped by an administrative apparatus hovering above the city. Instead existing ways of recording property that development in the City II has to rely on as well as existing slum listing take place, indeed are constitutive of a blurred space between urban administration and urban society. In this space alliances among various actors blur the line between Scott's (1998) two analytical poles of state versus (local) society both in terms of interests as well as in terms of roles and membership of a person.

This space, which I called, the "amorphous state," explains why both SDI- and non-SDI based practices of legibility making are caught in a sort of "forever-now" of infrastructuring at the point of populating databases and listing slums/residents. Property databases and slums lists are under continuous (re-) construction. SDI development hovers above urban governance in the sense that it is caught in a loop of implementing new survey techniques and organizational set ups to produce (envisioned permanent) official knowledge rather than actively supporting the implementation of larger scheme goals or strategic urban planning and development. Non-SDI based practices of legibility making in the case of the slum improvement scheme do support implementation of scheme goals, albeit in a fragmented and ad-hoc fashion.

For an emergent SDI to consolidate into a stable sociotechnical network, eventually unnoticed, black-boxed, and sunk invisibly into administrative practice that governs the city from afar, requires not only the efforts involved in legibility making as such, but also the creation of its precondition: the drawing of a clear-cut line between administration, on one hand, and (urban) society, on the other. In this double-feat SDI development faces existing people-paper-place associations, an existing paper infrastructure, that produces and runs on the opposite of official knowledge as conceptualized by Scott (Carson, 2011; Scott, 1998), namely on ambiguous, temporary, non-standardized and fragmented multiplicities of knowing. This paper infrastructure is implicated by members of administration and their interests in retaining fragmented and multiple forms of knowing.

The consequences of succeeding in this double-effort are difficult to predict and can be viewed in more positive or more negative terms with respect to broader governance ideals at hand, including public accountability, the nature of government improvement scheme implementation, citizen participation, inclusion of people as urban citizens as well as possibilities to secure basic livelihoods. These implications form useful hypothetical entry points for future research.

6. Reflection and future directions

In this final section I will first reflect on the contributions this thesis makes to the SDI knowledge domain, as well as methodological contributions and shortcomings (6.1). In the last section I will sketch out three directions for future research and practical considerations for SDI development (6.2).

6.1 Reflection: main contributions and shortcomings of the study

The most important contribution of this study pertains to the knowledge domain of SDI research and development. The empirical focus on digital property database development in Indian cities addresses a gap in research on SDI development in the global south and at sub-national level (Nedović-Budić et al., 2011). It is the only ethnographic attempt to-date to critically reflect on SDI development in India, specifically in comparison with non-SDI based practices and especially in Indian cities.

Within the context of India, the empirical focus on the urban arena is timely and relevant, because South Asia will soon be the most populous region in the world and major Indian government improvement schemes, such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and more recently Rajiv Awas Yojana (RAY), target specifically cities. E-government, especially in the form of digital land administration systems, citizen e-grievance systems (Martinez et al., 2011; Ranganathan, 2012; Richter, 2011; Teffelen, van and Baud, 2011), and GIS for data management of slum areas under the recent RAY scheme are characteristic elements of neo-liberal reforms, urban renewal, and administrative decentralization efforts. Only recently have researchers turned attention to the urban arena in Karnataka to study the processes by which spatial technologies actually become implemented in government, the actors, interests and rationales involved, as well as the socio-political implications of these processes (Raman, 2012; Ranganathan, 2012; Virkar, 2014 forthcoming; 2014a forthcoming; 2014b forthcoming). These studies have mainly focussed on the capital city and region of Bangalore. Regions outside of mega-cities have received less scholarly attention. My study broadens the view to include relatively smaller cities (in Indian terms). This is relevant in so far as there is indication that governance processes in smaller and medium-sized cities work differently from large cities, but these processes may also change in the near future as the cities are growing and increasingly come under the influence of visions and developments that characterize large cities (Desai and Sanyal, 2012). For instance Mugdali's development has been increasingly influenced in the past decade by IT-industry related development in Bangalore. My study thus lays the groundwork for future studies of implications of and opportunities for SDI development within a changing urban landscape in India.

Beyond these empirical contributions to SDI research, the comparison of SDI-based and non-SDI based practices in conjunction with an inductive move via an infrastructural inversion into conceptualizations inspired by political science and anthropologies of the state literature allowed me to contextualize SDI development in the broader landscape of administrative practice beyond the islands of emerging digital networks, to link SDI development to aims of government improvement schemes, and in turn to discuss possible implications of SDI in urban governance. SDI development faces the double-challenge of legibility-cum-state making in the case of urban governance in Karnataka. This tricky scenario may be applicable in other empirical contexts, where we cannot assume a consolidated state clearly demarcated from “its society” below. This pertains to other areas in the global south. For example, ethnographic studies pointing to the dispersed, even imagined, nature of the state draw on empirical material from diverse contexts, including rural India (Gupta, 2006), Africa and India (Ferguson & Gupta, 2002), Indonesia (Li, 2005; 2007; Timmer, 2010), and rural Mexico (Nuijten, 2004). It may also be of interest to research in regions, where SDI development takes place under governance regimes characterized by high levels of digitalization and in parallel to open government and Big Data initiatives. It may be argued, for example, that Prins, Broeders, & Griffioen’s findings (2012) indicate an increasingly amorphous state and the blurring of the boundaries between state and private industry as a consequence of data flows and exchanges that have run out of (state) control.

Section 3 of the thesis makes the perhaps most important methodological contribution of my study. By elaborating on the process of interpretation as it took place in dialogue with empirical insights gained and considering the researcher’s own positionality within the larger research program my aim in section three was to make transparent, how “the field” also extended into the home and the site of interpretation (Crang, 2005) and vice-versa. This process of interpretation is often left to the footnotes, where elaborate descriptions of fieldwork and data collection dominate the account of multi-site ethnographies (Hannerz, 2003; Salzinger, 2004). Making the process of interpretation more transparent is perhaps one of the most challenging, but also important aspects in multi-site ethnographies, and arguably even more so for researchers working in integrated research programs aiming at interdisciplinary collaboration and publications, providing for contingencies that do bear additional influence on the individual interpretive endeavor.

Furthermore, this study contributes methodologically within the realm of SDI research as it responds to repeated calls for the application of II theory to study SDI development (Aanestad, Monteiro, & Nielsen 2007; Budhathoki & Nedović-Budić, 2007; Georgiadou, Puri, & Sahay, 2005). Through the interpretive moves elaborated on in section three I sought to systematically

apply key lessons from II theory while at the same time gradually moving from an inside of the network to an outside of the network perspective. These key lessons include theoretically established properties of II, such as its emergent nature, its reach in scope, but also its local embeddedness in human organizing and practice. The moves elaborated in section three lead us from the "in-tensions" to infrastructure among City II participants (II as emergent) via classifying practices as intrinsic to both SDI development and human organizing beyond the network, into the broader realm of legibility making practices in government improvement schemes. In their entirety these moves constitute an infrastructural inversion, an approach which helped to avoid producing "analyses and recommendations about how to do [SDI] and how to smooth the workings of [SDI]" and instead to "ask questions which go in the opposite direction" (Pollitt & Hupe, 2011, p. 653), namely in how far the future matches existing practices and eventually ask, what may be gained or lost in the process of SDI development.

My Speculations of gains and losses as possible implications of SDI development in urban governance, including implications for public accountability, possibly improved access to the city for the so called "floating population," the potential loss of reversibility in the process of scheme implementation and loss of organic forms of participation, as well as the risk of endangering livelihoods that depend on the existence of an amorphous state, make a contribution in so far as they provide entry points to future research as well as anchors for SDI practitioners and participants to reflect on the development endeavour in terms of potential pitfalls that have thus far been off the radar in literature and research on SDI.

Through a detailed study of two practices of knowledge production in government improvement schemes (SDI-based and non-SDI based) the study also makes an empirical contribution to recent anthropologies of the state and further amplifies Scott's analytical scheme through the notions of amorphous state and "temporary legibility making," which may be considered theoretical points of interest. However, I cannot claim to make significant contributions to an explicit theory. The significance of both terms arises more within the framework of my specific research and process of interpretation. They provide anchor vocabulary intended to bring to light certain aspects of a wide, hidden, and complex paper infrastructure that spans throughout the city and in comparison with the new efforts to infrastructure through SDI-based practices.

Two notes of caution are in order with respect to the applicability of these notions and the implications discussed in section 5.2 in other empirical contexts. These derive from two methodological short-comings. First, it is important to note that the organic forms of participation, which I discuss in

section 5.2. may be specific to the cities included in this study. Although as previously mentioned, the size and type of cities (mid-size cities and relatively traditional, especially Mugdali) included in this study is valuable, because much research to date has focused on Indian mega cities. But the *nature of the cities included in this study also carries potential pitfalls in terms of applicability of findings to other cities and states*. It may well be that the interactions between urban actors in Mugdali, Dhabunagar and to a certain degree Kadovali, are less conflictual compared to large cities like Delhi. The latter, for example, has a different history and deep class conflicts and “one cannot help but wonder then whether the state’s response might change” as Mugdali grows and “other rationalities begin to influence decision-makers around the urban environment” (Desai & Sanyal, 2012, p. 21). Furthermore, Karnataka has a reputation for being advanced in the implementation of ICT in government as well as private domain. A study conducted in cities of Bihar or Orissa may provide a different picture from the one painted in this thesis.

Second, the state is also amorphous in its entanglements and interactions with the private sector and international policy makers and funding agencies. The importance of external funding agencies on SDI development has been investigated, for instance, by Lance, Georgiadou & Bregt (2012) for the case of African SDI. Various private entities influential in the design and implementation of Nirmala Nagara remained in the shadows of my research, for instance the degree and nature of influence by the E-government Foundation. *The blurring of the state’s boundaries towards the international and private industry arena has been neglected in this study* mainly due to my empirical focus on resident – municipal administrator interactions in cities.

I have summarized the main contributions and shortcomings in text box 6.1. In the final section of the thesis both contributions and shortcomings serve as road signs pointing to future research directions.

Main contributions:

- The original angle this study provides to the knowledge domain of SDI is afforded by the combination of research topic (SDI) and empirical context (Indian cities) studied through a multi-site ethnography and the application and adjustment of concepts derived from both II theory and anthropologies of the state.
- Five possible implications of SDI development in urban governance are discussed based on preceding interpretations, which provide hypotheses for future research and themes for reflection among participants in and practitioners of SDI development.
- The study makes an empirical contribution to and offers "theoretical points of interest" to anthropology of the state literature and research, such as "temporary legibility making" and "amorphous state."

Main shortcoming:

- The study neglects another "blurred boundary" of the state: state-private industry relations and relations between the state and international agencies and funders, which are influential in the development of SDI and bears influence on SDI's implications in governance.
- Transferrability (in conceptual terms) of research findings to other (Indian) cities remains to be explored in future research.

Text box 6.1.1: Summary of the main contributions and shortcomings of the thesis

6.2 Future research directions and considerations for practice

Three research directions open up from this study based on the implications discussed in section 5.2, the study's shortcomings, as well as recent spatial technology developments in governance in the form of open data and related applications. I illustrate the latter two directions with one more empirical case from fieldwork, an SDI initiative from rural Karnataka. This final section of the thesis will close with considerations for SDI practice and development.

The first and most obvious question arising from this research is in how far SDI will eventually take hold in urban governance in India, and in how far the conclusions drawn are applicable also to recent similar initiatives, such as the National GIS or Rajiv Awas Yojana. Possible future implications of SDI development in urban governance discussed in section 5.2 provide useful hypotheses in following this research direction, for example in order to explore, whether SDI would indeed provide for improved accountability of the state or in how far it may extinguish organic forms of participation.

Furthermore, given the double-feat of legibility-cum-state making, SDI development may require a fair amount of force, for instance via legal

means. This has been noted by participants of the Indian NSDI, who emphasize that the initiative needs to be backed up by "the law." According to a DST official, for instance, laws are required in order to force administrators to use GIS in their planning and decision making processes. Indeed, there is indication that legal force behind SDI development is being deployed already. For instance, there have been attempts to back up the Delhi State Spatial Data Infrastructure (DSSDI) by legal means through a 2011 Act. The act intends to make the use of and contribution to DSSDI data mandatory for government departments and other participating entities in the National Capital Territory (NCT) of Delhi through the creation of a coordinating body (Government of NCT Delhi, 2011). Especially in land administration, legal status would provide a given property and tenure database with substantial weight in governance processes as data provided therein would constitute evidence of ownership in courts. Contestations over which database would eventually hold this status was an issue itself still pending in court at the time of my study. Related to research on the future of SDI development, are therefore questions concerning if, how and to what effect legal measures are deployed in the development of SDI.

A second direction for future research leads along the other blurred boundary of the state, namely vis-à-vis the private sector and international agencies and funders. Following Ranganathan's (2012) argument, the implementation of e-governance would not only entail a rescaling of the state through a centralization of decision-making authority (in line with the argument of SDI development as state-maker), but also facilitate increased influence of corporate and private actors in urban policy. Future research questions may address the extent and nature of influence of private industry and international agencies on the development of SDI and implications for urban governance. In this respect, at least in the Indian context, it will be important to consider the nature and role of "semi-autonomous bodies" and other hybrid forms of organization, which occupy the spaces between state, society, private industry, and international agents. Furthermore, it will be worthwhile considering new forms of spatial technologies and data produced, provided, and combined by state-external players, such as Google as well as by citizens. These two recent developments - organizational and data related - may afford new opportunities for SDI development as they may help to circumvent the difficulties of integrating the state as well as its data holdings.

At this juncture a third research direction opens up leading into the realm of hybrid forms of organization and open data sources and use. As mentioned in the introduction SDI development currently sits a bit awkwardly between its original core tenets and these more recent developments. In the U.S.A. SDI has recently been merged under the Open Government Data (OGD) Initiative. The release of data by government for public and private use

rather than first integrating the data holdings of various government departments characterizes new transparency policies, such as targeted transparency (Georgiadou, Lungo, & Richter, 2013). One rationale behind open data initiatives lies in addressing very specific societal problems through the combination of large amounts of highly detailed data available online and from citizen-generated data sources. The challenge for future research is to explore, where these initiatives take us in the long run. For instance, what are the implications in terms of government accountability and citizen participation, what inferences are being made on the basis of multiple-source, highly detailed data, and what are the effects of these inferences on socio-spatial classifications, the identity of individuals, and government or non-government interventions in people's lives (Georgiadou, et al., 2013; Johnson & Sieber, 2011; Shkabatur, 2013; Stalder, 2011; Starr, 1992)?

In order to further elaborate on the third research direction as well as to draw implications for SDI development practice, I will draw on additional empirical material from my research. I briefly highlight several characteristics in the development of the Karnataka State Natural Disaster Monitoring Centre (DMC). I stumbled across this SDI of sorts during fieldwork more or less by chance, but did not include it in the material for interpretation in this thesis, because the initiative targets rural areas and as such falls outside the framework sketched out for the study (focus on the urban arena). The DMC originates in administration, but at the time of fieldwork the Director was applying for semi-autonomous status of the centre. A central GIS database is located at the nodal office in Bangalore used to generate reports and real-time information about flooding and drought events in rural areas of Karnataka. Initiated in 1987 and a 2010 ESRI-awardee the centre has grown to cover all villages across the state, and now also combines data from the University of Columbia, USA and Indian Meteorological Department for general weather forecasts and analyses. The beneficiaries are mainly farmers and village administrators. Both can access information via internet in village kiosks and both receive weather updates and flood or drought warnings via SMS as well as in the form of analogue reports.

In the Director's account of how the network gradually expanded (while listening to his account I was many times reminded of ANT), several points can be highlighted as basis to elaborate on additional future research directions. These points are also informative for the practice of SDI development in addition to the conclusions drawn in the thesis earlier. First, at the very beginning the timing for the instalment of first rain gauges across the state was important in order to procure funding and expand the network of rain gauges and later additional equipment across the state. This point in time was a moment of crisis, a major flood event in the state, as well as a time of opportunity, when the then Chief Minister initiated e-government and

e-governance reforms in Karnataka. It was important to show to state-level administrators that the data to remedy flood-related losses was available in real time, quickly, reliably and continuously. To provide evidence, the Director sent text messages with new data several times per day to key administrators in charge of budget. Second, to maintain the system it was important from the beginning to embed the technology in the socio-cultural context and practices of village communities rather than seeking to circumvent existing practices and relations between village administration and farmers. For example, the rain gauges are maintained by the village community, and vandalism or theft have never been a problem. The reason, according to the Director, was the instalment of gauges and related equipment on top of the Gram Panchayat (village-level administration) building. This gave the initiative visibility at local village level and endowed equipment with communal value increasing farmers' trust in the technology and perception of its usefulness. Third, the centre now also integrates citizen-generated data. The office in Bangalore includes a call centre, which receives calls and SMS messages from farmers about local weather conditions. This "crowd-sourced" (in the words of the Director) information is incorporated into analyses in order to fine-tune the forecasts generated in the centre: "If a farmer calls me and says 'my roof is leaking,' we also know it's alert time for that area" (DMC Director). Fourth, expanding the system requires speed and anticipating the future in terms of very specific purposes and needs of new actors to be enrolled. For example, during my fieldwork, crop insurance companies were becoming enrolled as users of the centre's analyses, forecasts, and reports. The Director explained, that he studied reports and documents of crop insurance companies in order to anticipate, how DMC-generated analyses can benefit the companies and in how far analyses and data may be adjusted to generate reports applicable to the companies' needs.

The four points distilled from the Director's account suggest several considerations for SDI development practice. In light of the double-feat to be achieved by SDI development in Indian urban governance – and potentially elsewhere – it would make sense to consider working with and through the amorphous state rather than seeking full governmental integration in organizational and technological terms. Such endeavor might entail experimentation with hybrid forms of organizations cutting across governmental, private, and societal boundaries as in the case of semi-autonomous bodies (along the "blurred state boundary" which my study neglected) and as the recognition of established villager-administrator relations in DMC development illustrates (along the "blurred boundary" between state and local society, that forms the focus of my thesis).

SDI in practice may also more explicitly consider and foster the inclusion of data, applications, and services produced and provided by non-governmental agents. However, given the diversity and amounts of data becoming available and the risks of mistaken inferences drawn on the basis of data, it is important to identify specific and pragmatic needs, uses, or problems, which are already on the policy agenda or on the public radar at a certain point in time. Rather than seeking to achieve integration of as much data as possible and deploying the most cutting-edge technology in hopes that data and services will find various users, who in turn will address multitudes of societal problems, a more fruitful approach may be to start with the simple question "how can this problem be solved" and to activate available technological and organizational resources accordingly. What is important in this respect is also the ability to anticipate the future to some degree and to make use of opportune moments as the DMC case shows.

This also means that criteria to evaluate the efforts of SDI development in different contexts need to leave established frames of reference in the form of expected grand designs that link a set of technical and organizational components. Similar to conceptual frameworks in research, where scientists hope to make contributions to theory via empirical studies, why not allow evaluation matrices for SDI development to be expanded, rearranged, or even abandoned in the course of development depending on place, time, and purposes?

A difficult and yet important challenge is to build means into the process of SDI development, which actively engage practitioners to (regularly) reflect on and adjust development to the "interpretive flexibility" of SDI. This pertains not only to different meanings SDI holds for stakeholders enrolled in the process, but also for those excluded from the endeavor, those outside the evolving network. As SDI practitioners and researchers we need to engage in a kind of work which is generally left up to those excluded from a network, the work, which Graeber (2012, p.118) calls "interpretive labor," the "work of understanding how social relations really work" also outside of "our network" and with a perspective that makes our "rational path" look strange or even risky. In other words, as SDI practitioners we may have to engage in the difficult balancing act, which I found also Indian administrators involved in, namely looking out for the well-being of various groups of urbanites, on one hand, and driving the government scheme forward, on the other.

The example of enrolling crop insurance companies and possible consequences for farmers in the case of DMC illustrates that reflection and potential adjustments also need to account for changes in the meanings of SDI for a given group of people or stakeholders through time. In the DMC case, initial beneficiaries (the farmers) may experience unexpected negative

effects from the enrolment of crop insurance companies, which, from the perspective of network expansion, is a good thing. It is difficult to predict, how the combination of various data, analyses and predictions will impact insurance premiums, for instance. The latter may become adjusted to specific areas and conditions at a very fine-grained scale, but based on data that is decontextualized from the farmers' socio-political situation and condition. It is at this junction, where problems of decontextualized data interpretations arise (Prins et al., 2012). These problems include questions about the legitimacy of inferences made based on free-floating data particles as they are merged and endowed with new meanings. Arguably, this is even riskier when predictions are made about the behavior and identities of individuals (Starr, 1992) rather than weather patterns. Future research needs to tackle a scenario without "natural limits to information gathering," where information is often considered on a case-by-case basis, and "without clear guidelines on the extent to which the public and private sectors are allowed to overlap 'informationally' "(Prins et al., 2012; p.3).

In addressing this topic, future research and SDI development are thus faced empirically with a rather unpredictable scenario, where high degrees of data integration do not necessarily coincide with coherent, formally delineable organizations to serve analytical purposes, such as "the state," "the society," or "the private sector." *To tackle these challenges in research and practice requires also rethinking and experimenting in methodological terms.* Two aspects are important here. One is the development of methods that allow users of many layers of globally spanning information infrastructures that crisscross public and private spheres to reflect on and look inside these data flows and (possible) implications on people's lives and society. Khovanskaya et al. (2013), for instance, show how mechanisms for this kind of reflection may be designed via applications that make infrastructure visible, that shed light onto the hidden rationales embedded in code and algorithms, and which show the sometimes strange, sometimes scary inferences that may arise from our plug-and-plays with online data sources. The second methodological aspect pertains to the need for research to actively engage in imagining the future. For instance, Forlano (2013) suggests for ethnography to learn from science fiction and speculative design methods. More specifically she proposes "design friction," which would use "alternative futures and storytelling methods from speculative design in order to interrogate the gaps and seams [of urban technologies] that we uncover through ethnographic research."

Summary of future research directions and considerations for SDI development practice:

Future research directions:

1. Will SDI take hold in urban governance in India, for example by legal measures, and if so, what are the consequences?
2. What are the extent, nature, and consequences of the relations between state, private industry, and international agents in SDI development in urban governance?
3. How will new developments in the arena of open data and hybrid forms of organization influence SDI development as well as urban governance (for example with respect to public accountability, citizen participation, the process of government scheme implementation, inclusion of different groups of people in the city and possibilities to make a living)?

SDI development practice:

- Working with and in the amorphous state rather than against it
- Focus on specific problems, incrementally activate technological and organizational resources together and seize opportune moments
- Develop flexible (in time and place) matrixes for evaluation of SDI development
- Build means into development process to reflect on and adjust to (changing) interpretive flexibility of SDI

SDI development and research:

- Develop and experiment with methods that help to imagine future scenarios arising from different possible people-technology interactions

Text box 6.2.1: Summary of future research and SDI development directions

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Summary

Since its conception in the United States of America, Spatial Data Infrastructure (SDI) as a name and as an account of desirable intra-government practices to share and reuse digital spatial data has travelled across the world. While a large body of research tackles technical challenges in SDI development, fewer scholars address sociotechnical and social challenges. There is also less research on the development of SDI as sociotechnical process at local administrative levels, especially in developing countries. My study, conducted within the framework of a NWO-Wotro integrated research program (2007-2012), contributes to filling this gap. It explores SDI development in the context of urban governance in India, specifically in the state of Karnataka and – more tangentially – in the state of Maharashtra.

Underpinned by a constructivist ontology data collection and interpretation were carried out through a multi-site ethnography, involving several extended fieldwork periods between 2008 and 2012. Empirical insights were played against literature and theory through an inductive approach. Over time, and while gaining a better understanding of the empirical context, I explored the usefulness of concepts proposed by researchers who work at the interface of Information Infrastructure (II) and Science and Technology Studies (STS) and have drawn on various ways to conceptualize II. At later stages I delved into additional affine literature from anthropologies of the state, specifically those who are more or less directly engaged in a dialogue with James C. Scott's concept of legibility. Bowker and Star's notion of an infrastructural inversion provided for a suitable analytical approach, because of the emergent nature of SDI in the empirical context at hand, where entrenched non-SDI based practices, such as slum listing, are in place before SDI hits the ground. This approach also brings into the picture the larger framework of Indian government improvement schemes rather than focusing solely on the perspective of actors involved in a given SDI initiative.

India initiated its National SDI (NSDI) in 2001 when a task force was set up to prepare a viable strategy and action plan. However, the Indian NSDI initiative finds little or no resonance in the administrative arena of urban Karnataka. Instead, the latter is characterized by a bewildering multiplicity of efforts and projects to develop Geographic Information Systems (GIS) for land administration, and more recently also to support the implementation of poverty alleviation schemes. These efforts are driven by national or state-level bodies and private enterprise. At the same time, these initiatives are engulfed by a sea of paper work. During fieldwork, it was difficult to miss that lists and tables, constructed and maintained on paper and in stand-alone desktop applications, played a more important role in routine administrative

work than digital maps and integrated GIS. Two government improvement schemes dominated the urban scene in India during the period of this study. One is the state-level initiative *Nirmala Nagara* (Clean City), the biggest e-governance project in the world. One of the components of this project is the development of a state-wide GIS for urban property mapping and taxation in Karnataka. The other is the *Jawaharlal Nehru National Urban Renewal Mission* (JNNURM), which includes the *Basic Services to the Urban Poor* (BSUP) mission, a poverty alleviation scheme targeting slums in cities across India. Information construction under BSUP does not include GIS development, but relies mainly on paper records in combination with a variety of stand-alone desktop applications.

My study had three aims. First, I explored how the development of digital urban property databases takes place as an instance of SDI development at municipal level. I focussed on the social and technical actors involved, rationales underlying this effort and the main problems encountered in the development of digital property databases. I found that the multiplicity of initiatives to map and record urban property ownership arises from competition among participants over funding and database maintenance as well as the different objectives of the projects and involvement of different administrative and non-governmental agencies with different mandates. Various projects introduce new survey techniques along with the promise to render technical and governable the complexities of urban land administration. However, the process of developing an eventually integrated digital property database entails two paradoxes. One is that the promise of standardization, comprehensiveness, and accuracy, underlying the introduction of new survey techniques, stands in the way of future integration into one centralized database at state-level. Integration would constitute an information basis serving multiple purposes, including property taxation and monitoring, legal tenure administration, as well as strategic urban land use and infrastructure planning. The other paradox is that each new survey technique introduced still has to rely on the processes (records as well as people and interests), which it seeks to eliminate. In combination these two closely related paradoxes explain why current SDI development is caught in the continuous effort to re-populate digital databases before reaching the vision of large-scale integration across databases and agencies and the use of such infrastructure for long-term planning.

The second aim of my study was to analyse practices of information construction in the context of BSUP, namely the practice of listing slums and slum residents. Again, I specifically looked at the actors involved, rationales underlying the practice, and in how far these match or do not match the core tenets reflected in Indian NSDI discourse. Here I found that the process of slum declaration is characterized by a multiplicity of slum and resident lists

instead of the compilation of one, comprehensive, permanent list of all slums in the city. This can be explained by the intermingling of two forces that converge in the listing of slums. On the one hand, slum listing is driven by formal criteria to define and delineate slums and residents as well as by formal procedure of declaration. On the other hand, a variety of interests intersect with both formal criteria as well as procedural steps, including real estate interests, multiple forms of claiming land and occupancy, and related vote bank politics. While formal procedure and a given set of criteria may be translatable into a digital GIS, the non-procedural forces that influence slum listing defy the logic of unambiguous classification of people and urban space. Importantly, this means that slum lists are not only constructed by administrators or according to purely administrative ideals and norms, but also by a variety of non-administrative people and interests in the city.

Both practices of information construction – GIS property mapping and slum listing – are essentially running on the assumption that the city needs to be made legible to administration in order to plan, implement, and monitor improvement scheme goals. The third aim of my study was therefore to compare, in how far these two practices reach the larger aims of their respective government improvement schemes, namely to increase and monitor tax revenue in the case of GIS property mapping under *Nirmala Nagara*, and to provide housing and basic infrastructure to slum residents under *BSUP*. The comparative analysis is based on the description of both the organizational set-up and survey techniques involved in the two legibility making efforts. The requirement for administration to produce comprehensive, accurate, unambiguous, and permanent knowledge is tightly inscribed into the survey techniques and organizational design of GIS property mapping, whereas slum listing takes place more organically based on existing survey techniques and following “traditional sites” of knowledge production. While neither of the practices achieves fully comprehensive and permanent knowledge, slum listing supports implementation better in terms of new houses being constructed, allocated and surrounding physical infrastructure provided, albeit in a fragmented and stop-and-go fashion. In how far these new houses and infrastructure constitute an improvement is a different story. In GIS property mapping, on the other hand, larger program aims become side-tracked; and much effort goes into disciplining district- and municipal level administration, as well as into monitoring the progress of survey work and digitalization rather than monitoring property ownership and tax revenues. Why the stop-and-go and why the side-tracking of goals? In both cases the assumption of an administration which unilaterally collects information about the city and pursues its goals accordingly does not hold.

Across these analyses a common theme emerged. The city is governed not only by administration. Existing practices of information construction take

place within, indeed are constitutive of, a murky space between urban administration and urban society, a space where alliances among various urban actors blur the line between two analytical poles: an imagined "administration up there" and a "(local) society down here." In this study I refer to this blurring of lines as the "amorphous state." The term captures not only the often lamented fragmentation across administrative departments and respective data and record holdings, for which SDI presents a remedy, but also the blurred boundaries between administration and urban society.

The amorphous state theme is important to SDI development in at least two respects. First, it explains problems of embedding SDI in administrative practices. SDI development is caught in a catch-22 scenario. It not only requires making the city legible through comprehensive database development, a difficult feat in and of itself, but must at the same time create the essential precondition for such legibility making, namely the clear delineation between the city (urban territory and people) and its administration. This is a difficult double-feat to achieve and at the moment leads to a fair amount of work and resources being put into the disciplining of lower level administration.

Second, the amorphous state also provides spaces for participation in governance by a variety of actors. Although these forms of participation are highly situation-specific and not necessarily democratic, they are, nevertheless, existing. If SDI succeeds as legibility maker and separates administration more clearly from the city and citizen, different implications are possible in urban governance. On the one hand, conditions to hold the state accountable and to make "citizens" out of so-called "floating population" may be the more positive outcomes. On the other hand, the clear delineation between the city and its administration could enforce more linear and as such irreversible means of implementing improvement schemes, it may extinguish organic forms of participation by urban residents, and could close flexibly-used urban spaces on which many current urban livelihoods depend.

The research findings open up various directions for future research. It remains to be seen – and researched - in how far SDI eventually takes hold in urban governance in India, perhaps via legal measures. Furthermore, the possible implications of successful SDI development sketched out above may provide useful hypotheses for future research as well as points of departure for reflection among participants in and practitioners of SDI development. The recently launched Rajiv Awas Yojana (RAY) government program requiring the development of GIS databases for collection and maintenance of slum information as well as the Indian National GIS initiative will give further impetus to the kind of research presented in this thesis. Future research may specifically tackle the role and influence of hybrid forms of

organization that span between state, society, international agencies, and private industry on SDI development. The last two were neglected in this study.

For practice, this research suggests that SDI development may require working within rather than against an amorphous state, for instance through new forms of organization beyond the state. SDI development may stand better chances for uptake in the urban arena if it focusses from the beginning on specific problems around which technical and social resources become incrementally allied rather than aiming at large-scale integration, comprehensiveness, and multiple possible uses of the envisioned database. Two aspects are important to an incremental approach. First, it requires identifying opportune moments in time, for instance a moment of crisis, which allows allying various actors and resources around the initiative. Second, it requires foresight and anticipation of rather specific future needs of agencies that may become enrolled and of possibilities afforded by data and technologies available in the near future. This then means that evaluation of SDI development requires flexible (in time and place) matrixes rather than globally applicable, more or less static assessment frameworks. Closely related is the need to build means into SDI development to re-assess and reflect on both positive as well as negative implications in urban governance depending on the perspective of social groups involved as well as social groups not involved, but who are impacted in the long-run.

Samenvatting

Geo-Data Infrastructuren (*Spatial Data Infrastructures, SDI*) hebben, sinds de ontwikkeling in de Verenigde Staten, wereldwijd naam gemaakt als een instrument voor het delen en hergebruiken van digitale ruimtelijke data binnen de overheid. Binnen de wetenschap is er veel aandacht voor de technische aspecten van de ontwikkeling van SDI, maar in mindere mate voor de sociale en sociaal-technische dimensies. Er is ook niet veel aandacht voor de ontwikkeling van SDI als sociaal-technisch proces met betrekking tot lokale overheden, voornamelijk in ontwikkelingslanden. Mijn onderzoek, uitgevoerd in het kader van een gezamenlijk NWO-Wotro onderzoeksprogramma (2007-2012) draagt bij aan het verminderen van dit gebrek aan aandacht. Het onderzoek richt zich op de ontwikkeling van SDI in de context van stedelijk bestuur in India, in het bijzonder in de deelstaat Karnataka en tevens ook in Maharashtra.

De verkenning van SDI ontwikkeling steunt op een constructivistische ontologie, waarvoor het verzamelen van gegevens en de interpretatie ervan is uitgevoerd door middel van een *multi-site* etnografie, gedurende meerdere langere periodes van veldwerk tussen 2008 en 2012. Empirische inzichten zijn getoetst aan bestaande literatuur en theorie door middel van een inductieve aanpak. Met het vorderen van het onderzoeksproces en door het verkrijgen van een beter begrip van de empirische context, verkende ik de toepasbaarheid van concepten die zijn ontwikkeld door onderzoekers die werken op het raakvlak tussen Informatie-Infrastructuur (II) en *Science and Technology Studies* (STS) om II te verbeelden. In latere stadia van mijn onderzoek maakte ik gebruik van verwante literatuur met betrekking tot de antropologie van de overheid (*anthropologies of the state*), in het bijzonder literatuur die min of meer een directe verbinding zoekt met het *legibility* begrip van James C. Scott's. Bowker en Star's standpunt van een infrastructurele inversie voorziet in een gepaste analytische benadering vanwege de opkomende aard van SDI methodologiën in deze empirische context, juist daar, waar de reguliere non - SDI gebaseerde praktijken, zoals het inventariseren van sloppenwijken (*slum listing*) wijdverbreid zijn voordat SDI wordt geïmplementeerd. Deze aanpak brengt ook het grotere kader van de Indiase overheidsprogramma's in beeld in plaats van zich uitsluitend te richten op het perspectief van de actoren die betrokken zijn bij een bepaalde SDI initiatief.

India startte zijn Nationale Geo-Data Infrastructuur (NSDI) in 2001 toen een taskforce werd opgericht om een levensvatbare strategie en actieplan op te stellen. Maar het Indiase NSDI initiatief vindt weinig of geen weerklank in de bestuurlijke arena van het stedelijke Karnataka. Deze is echter gekenmerkt door een verbijsterende hoeveelheid aan inspanningen en projecten om

Geografische Informatie Systemen (GIS) te ontwikkelen voor kadastrale doeleinden, en meer recent ook voor de uitvoering van plannen met betrekking tot armoedebestrijding. Deze inspanningen worden gestuurd door particuliere bedrijven en verschillende overheidsorganisaties op nationaal niveau en op het niveau van deelstaten. Tegelijkertijd worden deze initiatieven overspoeld met bureaucratische processen. Tijdens het veldwerk werd steeds meer duidelijk dat lijsten en tabellen op papier en *standalone* computer applicaties een belangrijkere rol spelen in de reguliere werkprocessen van de gemeentelijke administratie dan digitale kaarten en geïntegreerde GIS-systemen. Gedurende de periode van dit onderzoek stonden in de steden in India twee overheidsprogramma's centraal. Eén daarvan is *Nirmala Nagara (Clean City)*, een initiatief op deelstaat niveau en het grootste e-governance project ter wereld. Een onderdeel van dit programma is de ontwikkeling van een op GIS gebaseerd computer systeem om in Karnataka de gemeentelijke kadastrale registratie van onroerende zaken en zakelijke rechten in kaart te brengen voor belasting doeleinden. Het andere programma is de *Jawaharlal Nehru National Urban Renewal Mission (JNNURM)*, dat zich met het sub-programma *Basic Services for Urban Poor (BSUP)* richt op de inrichting en verbetering van basis voorzieningen in achterstandswijken. Het in kaart brengen van de gegevens voor BSUP omvatte geen GIS technologie, maar was vooral gebaseerd op gegevens op papier in combinatie met een aantal *standalone* desktop applicaties.

Mijn onderzoek had drie doelen. Ten eerste beoogde ik een beter begrip te krijgen van de ontwikkeling van digitale kadastrale databestanden binnen de SDI ontwikkeling op gemeentelijk niveau. De focus was hierbij op de sociale en technische actoren, de beweegredenen die ten grondslag lagen aan deze ontwikkeling en de belangrijkste problemen bij het ontwikkelen van digitale kadastrale databestanden. Het lijkt erop dat de hoeveelheid aan initiatieven voor het in kaart brengen van de gemeentelijke kadastrale situatie en het vastleggen van eigendomsrechten voortkomt uit de competitie tussen de subsidieverstrekker en de beheerder van het databestand, maar ook de verschillende doelstellingen van de projecten en de betrokkenheid van verschillende organisaties binnen en buiten de overheid, beiden met verschillende mandaten. Diverse projecten introduceren nieuwe survey technieken, samen met de belofte om stedelijke kadasters technisch toegankelijk te maken en zo ook beheersbaar en bestuurbaar te maken. Echter, het proces van het ontwikkelen van een geïntegreerd digitaal kadaster omvat twee paradoxen. Ten eerste staan de beloftes van standaardisatie, volledigheid en nauwkeurigheid de toekomstige integratie in een centrale databank op deelstaatniveau in de weg. Dit vormt een probleem aangezien die beloftes de basis zijn voor de introductie van nieuwe survey technieken. Integratie in een centrale databank zou brongegevens kunnen leveren voor meerdere doeleinden, waaronder vastgoedbelasting, kadastrale

en juridische administratie, maar ook strategisch stedelijke planning van landgebruik en infrastructuur. De andere paradox is dat elke nieuw geïntroduceerde survey techniek nog steeds afhankelijk is van de processen (administratief maar ook mensen en belangen) die het beoogt te elimineren. Deze twee aan elkaar gerelateerde paradoxen samen verklaren waarom de huidige SDI ontwikkeling blijft hangen in de voortdurende inspanning om digitale databestanden opnieuw te produceren en men daardoor niet de visie realiseert databanken en organisaties grootschalige te integreren en te gebruiken voor planningen op lange termijn.

Het tweede doel was om te onderzoeken hoe informatie met betrekking tot BSUP wordt gegenereerd, met name hoe de inventarisatie van sloppenwijken en sloppenwijkbewoners in de praktijk gebeurt. Ook in dit geval richtte zich het onderzoek op de betrokken actoren, de beweegredenen die ten grondslag lagen aan de praktijk en in hoeverre deze overeenkwamen met de basisprincipes van de Indiase NSDI. Het onderzoek laat zien dat de inventarisatie van sloppenwijken een verzameling is van een veelvoud aan sloppenwijk- en inwonerlijsten in plaats van de compilatie van één, uitgebreide, vaste inventarisatie van alle sloppenwijken in de stad. Dit kan onder andere worden verklaard door het samenspel tussen twee krachten die samenkomen in het definiëren van sloppenwijken. Aan de ene kant gebeurt het definiëren en afbakenen van een sloppenwijk en het inventariseren van zijn bewoners op basis van formele criteria en procedures. Aan de andere kant spelen verschillende belangen een rol die gerelateerd zijn aan formele criteria en procedurele stappen, waaronder vastgoed belangen, belangen gerelateerd aan manieren voor het aanspraak doen op en het bezitten van land en gerelateerde *votebank politics*. Terwijl formele procedures en harde criteria naar een digitaal GIS bestand vertaald kunnen worden, zijn het juist de niet-procedurele invloeden die een eenduidige classificatie van inwoners en de stedelijke ruimte bemoeilijken. Het in kaart brengen van een sloppenwijk wordt dus niet alleen bepaald door beheerders of volgens eenduidige administratieve idealen en normen, maar ook door verschillende personen en belangen in de stad buiten de gemeentelijke administratie.

Beide praktijken van informatietechnologie – het in kaart brengen van het kadaster met behulp van GIS en de inventarisaties van sloppenwijken – worden voornamelijk uitgevoerd in de veronderstelling dat de stad “leesbaar” (*legible*) moet zijn voor overheden om herstructureringsprogramma’s en doelstellingen te plannen, implementeren en bewaken. Het derde doel van mijn onderzoek was dan ook om een vergelijkende analyse op te stellen van in hoeverre deze twee praktijken de grotere doelstellingen van de respectievelijke overheidsprogramma’s van de betreffende overheden halen. Deze doelstellingen omvatten ten eerste de verhoging en monitoring van de belastinginkomsten, gerelateerd aan het karteren van onroerend goed

eigendom door middel van GIS, als onderdeel van Nirmala Nagara; en ten tweede het voorzien in huisvesting en basisbehoeften voor sloppenwijkbewoners als onderdeel van de BSUP. De vergelijkende analyse is gebaseerd op de beschrijving van zowel de organisatorische opzet als ook de survey-technieken die basis zijn voor het ontsluiten van de bron gegevens. De eis aan overheden om volledige, accurate, eenduidige en blijvende kennis te produceren is een basisbeginsel voor de survey technieken en de organisatorische opzet van een op GIS gebaseerd kadastraal system. Dit staat in contrast met het inventariseren van sloppenwijken dat meer organisch gebeurt op basis van bestaande survey praktijken en het volgen van *traditional sites* van kennisproductie. Hoewel geen van de praktijken volledige ontsluiting van gegevens biedt, geeft het inventariseren een betere ondersteuning voor de verdere implementatie van nieuw gebouwde en toegewezen huizen en het voorzien van de benodigde fysieke infrastructuur, zij het ook met een gefragmenteerde en 'stop-and-go' werkwijze. In hoeverre deze nieuwe huizen en infrastructuur een verbetering vormen is een ander verhaal. Aan de andere kant verdwijnen bij een op GIS gebaseerd kadastraal systeem de hoofddoelen van het overkoepelde programma naar de achtergrond. Er gaan veel middelen naar het formeel organiseren van de administratie van het wijk- en gemeentelijk niveau, het bewaken van de voortgang van de survey en de digitalisering, in plaats van dat er toezicht wordt gehouden op kadastrale eigendomsrechten en de belastinginkomsten. Waarom de 'stop-and-go' werkwijze en waarom de marginalisering van de hoofddoelen? In beide gevallen is de veronderstelling dat een lokale overheid die één gezamenlijke lijn volgt en tevens volledige informatie verzamelt over de stad niet vol te houden.

Uit de verschillende analyses komt een gemeenschappelijk thema naar voren. De stad wordt niet alleen beheerst door de gemeentelijke administratie, maar bestaande praktijken van de generatie van informatie vinden plaats binnen, c.q. zijn gefundeerd op, de niet transparante wisselwerking tussen stadsbestuur en de stedelijke samenleving, een wisselwerking waar allianties tussen verschillende stedelijke actoren de lijn vervagen tussen twee analytische polen: een ingebeelde "overheid in haar ivoren toren" en een "(lokale) samenleving hier beneden." In dit onderzoek verwijst ik naar het vervagen van deze lijn als de "amorfe overheid." De term behelst niet alleen de vaak ter discussie gestelde versnippering tussen administratieve diensten en de bedrijven die gegevens registreren en beheren, waarvoor SDI een remedie voor biedt, maar ook de vage grenzen tussen de overheden en de stedelijke samenleving.

Het thema van de amorfe overheid is belangrijk voor de ontwikkeling van SDI in tenminste twee opzichten. Ten eerste verklaart het de problemen omtrent het integreren van SDI in administratieve processen. De ontwikkeling van

SDI is gevangen in een *catch-22 scenario*. Het vereist niet alleen dat de stad inzichtelijk wordt gemaakt door middel van de ontwikkeling van uitgebreide databestanden, een uitdaging op zichzelf, maar ook dat tegelijkertijd de essentiële randvoorwaarden worden gecreëerd voor het beschikbaar maken van die gegevens. Dit laatste wordt mogelijk gemaakt door een duidelijke afbakening te definiëren tussen de stad (het stedelijke gebied en haar inwoners) en de overheid. Het bereiken van deze twee doelen is een grote uitdaging en leidt er op dit moment toe dat een grote hoeveelheid aan werk en middelen wordt opgemaakt om de lagere administratieve eenheden van de overheid te disciplineren.

Ten tweede biedt zo een amorf overheid ook ruimte voor participatie in het stedelijke bestuur door verschillende actoren. Hoewel zulke vormen van participatie zeer situatie-specifiek zijn en niet per se democratisch, bestaan ze desalniettemin. Als SDI slaagt in het ontsluiten van informatie en een duidelijker onderscheid creëert tussen de overheid en haar burgers, zijn verschillende implicaties mogelijk in het stedelijk bestuur. Een met name positief resultaat is dat de overheden verantwoording moeten afleggen en dat burgers uit de positie worden gehaald van een *floating population*. Daarnaast kan een duidelijke afbakening tussen de stad en haar overheid leiden tot een meer lineaire en als zodanig onomkeerbare uitvoering van herstructureringsplannen. Een mogelijk nadeel hiervan is dat organische vormen van burgerparticipatie teniet worden gedaan en dat het deel van de stedelijke ruimte dat nu flexibel wordt gebruikt, bijvoorbeeld voor het levensonderhoud van burgers, verdwijnt.

De resultaten van dit onderzoek geven ook richting aan toekomstig onderzoek. Het valt nog te bezien - en het moet onderzocht worden - in hoeverre SDI uiteindelijk wordt opgenomen in het stedelijk bestuur in India, wellicht afgedwongen via wettelijke maatregelen. Daarnaast kunnen de mogelijke implicaties van een succesvolle ontwikkeling van SDI zoals hierboven geschetst een handvat bieden voor het opstellen van bruikbare hypothesen voor toekomstig onderzoek en uitgangspunten bieden voor reflectie bij mensen die met SDI werken. Het onlangs door de overheid gelanceerde programma *Rajiv Awas Yojana* (RAY), dat onder andere de ontwikkeling van dynamische GIS databases van sloppenwijken beoogt, als ook het Indiase Nationale GIS initiatief zullen een nieuw impuls geven aan het soort onderzoek beschreven in deze thesis. Toekomstig onderzoek kan zich dan specifiek richten op de rol en invloed van hybride organisatievormen die door SDI ontstaan tussen overheid, maatschappij, internationale actoren en de particuliere sector, waarvan de laatste twee buiten beschouwing zijn gelaten in dit onderzoek.

Met betrekking tot toepassingen in de praktijk suggereert dit onderzoek dat SDI ontwikkeling samen in plaats van tegen een amorfe overheid moet werken, bijvoorbeeld door de ontwikkeling van nieuwe vormen van organisatie die niet gebonden zijn aan een overheid. Het ontwikkelen van SDI heeft de grootste kans op toepassing in de stedelijke bestuurlijke omgeving als het zich vanaf het begin richt op het gebruiken en integreren van de in de samenleving aanwezige technische middelen en sociale capaciteiten, met behulp waarvan vervolgens stapsgewijs innovatie plaats kan vinden. Dit is beter dan een meer *top-down* benadering waarbij integratie op grote schaal wordt beoogd en men alle mogelijke toepassingen vanaf het begin probeert af te dekken. Voor een stapsgewijze aanpak zijn twee aspecten belangrijk. In de eerste plaats vereist het dat opportune situaties, bijvoorbeeld een moment van crisis, worden geïdentificeerd. Dit zijn vaak momenten waarop coalities van verschillende actoren en middelen gesmeed kunnen worden om een bepaald initiatief te ondersteunen. Ten tweede vereist het een vooruitziende blik en de capaciteit om te kunnen anticiperen op specifieke toekomstige behoeftes van betrokken instellingen en de mogelijkheden die gegevens en technologieën zullen bieden in de nabije toekomst. Dit betekent dan dat de evaluatie van de ontwikkeling van SDI flexibele (in plaats en tijd) matrixen vereist in plaats van universeel toepasbare, min of meer statische toetsingskaders. Hieraan verbonden is de noodzaak om mogelijkheden in te bouwen in de ontwikkeling van SDI voor beoordeling en zelfreflectie over zowel de positieve als negatieve gevolgen voor het stedelijk bestuursstelsel, afhankelijk van het perspectief van de direct betrokken sociale groepen, maar ook de niet direct betrokken sociale groepen, die ook deelgenoot zijn van de gevolgen van de ontwikkeling van SDI op de lange termijn.

Academic biography of author

Christine Richter studied Geography and Ethnology at the University of Leipzig, Germany, and continued her studies at the University of Denver, U.S.A., where she received Bachelor and Master of Arts degrees in Human Geography. During and after her studies she worked as Geographic Information Systems (GIS) technician and cartographer with the National Parks Service, the City and County of Denver in community planning and development, and at Norwest Engineering in natural resource and energy consulting.

In 2008 she joined the NWO-Wotro integrated research program (exploring how SDI can be used by urban governance networks to tackle urban deprivations in India) as a PhD student at the Faculty of Geo-information Science and Earth Observation (ITC) at the University of Twente, The Netherlands. Since January 2013 Christine is lecturer and researcher at the Department of Human Geography, Planning and International Development at the University of Amsterdam.

Peer-reviewed publications:

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Outstanding Geoscience Student Award by the Association for Women Geoscientists, U.S.A., 2002 and 2005
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ITC Dissertation List

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