Design of an unbounded ethnography of spatial information infrastructure development

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ABSTRACT

In this paper we introduce a research program for the study of spatial information infrastructure development to tackle urban deprivations in Indian cities involving European and Indian researchers.

We conceptualize the SII as evolving installed base embedded into existing practices of spatial information use. To study the evolution of the SII we propose an unbounded ethnography in order to address the problem of actors and actions that are not spatially and temporarily confined to one or two cities in India, but that emerge and possibly converge in different places and times across cities in India and Europe. We propose a multi-sited, multi-method study about the emergence of action nets within the context of the research program.

The proposal of such a research design is largely informed by our involvement in the program during the past year with researchers in Europe and India, and a pilot study in public administration offices in one southern Indian city.

To show, how this involvement influenced the research design we outline initial empirical findings from this first year of work in the program.

1. INTRODUCTION

In a 2008 editorial of GeoConnexion Roger Longhorn makes an appeal to view spatial data infrastructure (SDI) not as a thing, but as a process, "comprising many different and disparate elements, which will be implemented in different ways, at different speeds, different costs (and benefits) and with different impacts."

The research project we discuss in this paper affords the opportunity to approach spatial information infrastructure (SII[1]) development along the lines of Longhorn's appeal as a process and to study how different elements of a SII emerge globally.

Specifically, we want to discuss an approach to the study of SII development for urban governance to tackle poverty in Indian cities. The role such an information infrastructure can play in urban governance is the focus of a five year research program initiated by European and Indian researchers.

We structure the rest of the paper as follows. In the first part, we briefly outline our theoretical conceptualization of information infrastructure. Next, we will illustrate the problem we face in this study. Thirdly, we describe the current design for addressing the problem and approaching the research on the basis of "first lessons learned" from initial empirical data. We conclude with the practical relevance of this study to spatial information infrastructure development.

2. THEORETICAL CONCEPTUALIZATION OF SPATIAL INFORMATION INFRASTRUCTURE

We conceptualize information infrastructure (II) along the lines of Hanseth, Lyytinen, and Monteiro's information infrastructure theory (Hanseth, Lyytinen, 2004; Hanseth, Monteiro, 1998). These authors define an information infrastructure as an evolving enabling, shared, and heterogeneous installed base. The concept of "installed base" implies that infrastructures always already exist in one form or another, and that the existing elements of an infrastructure influence future development. Various technical and non-technical elements of an installed base "evolve continuously and unexpectedly in that their boundaries are not fixed

[1] We intend SDI and SII as synonyms.

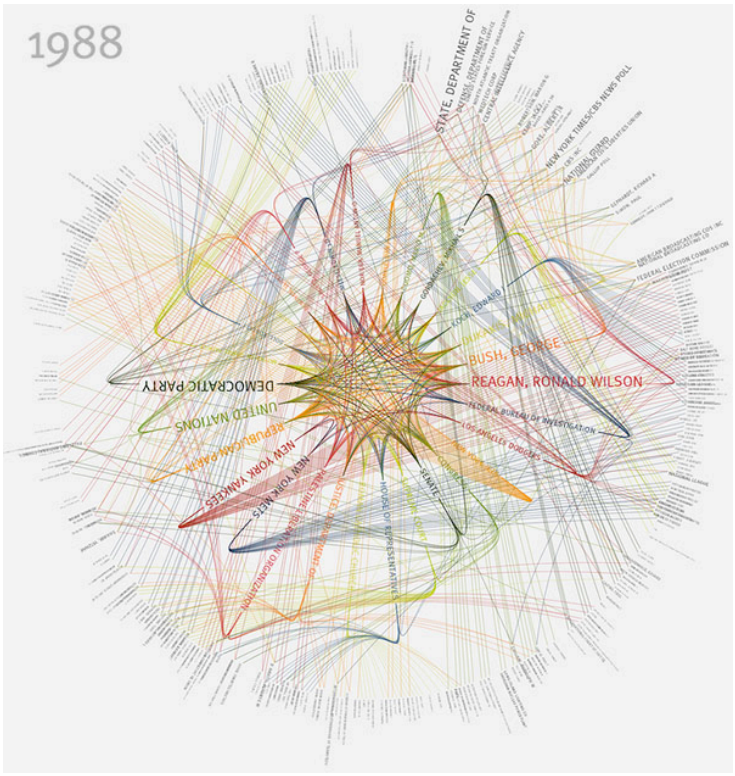
beforehand," and the II's "services and associated components will expand (or sometimes shrink) in time and space in an organic manner" (Hanseth, Lyytinen, 2004, p. 214). The elements of an information infrastructure are heterogeneous in terms of technological components, humans, organizations, and institutions, as well as sub-infrastructures linked together via gateways (Hanseth, Monteiro, 1998). In this sense, information infrastructures are continuously evolving socio-technical networks.

However, recognizing that many processes of such a socio-technical network are hidden and cannot be charted with lines and boxes (Longhorn, 2008) we also emphasize Star and Ruhleder's property of an installed base as "something that is 'sunk' into, inside of, other structures, social arrangements and technologies" (1996, 113), because infrastructure it closely tied to organized practices, and in fact is part of human organization (Star, 2002). This characteristic makes information infrastructure difficult to see and study, a problem we will illustrate in the following section.

3. THE PROBLEM FOR RESEARCH DESIGN

In the following we introduce the problem of studying SII conceptualized as continuously evolving socio-technical network without fixed boundaries and submerged in day-to-day practices.

Figure 1: One of a "series of visualizations [flickr.com] that represent the top organizations and people mentioned in the news articles of the New York Times for a given year of news between 1984 and 2009" (http://infosthetics.com/archives/2009/02/nytimes_yearly_visual_overview.html)



The description of a network shown in figure one is based on persons and organizations mentioned in New York Times. It is one example of many visualizations of networks and maps of flows using lines to connect various elements in a network. For our study, however, such descriptions are insufficient. Figure one, for example, is based on the construction of 'social' connections based on one source of data, whereas the II we attempt to study involves intricate intertwining of socio-technical activities spanning across geographic boundaries. Second, changes through time and interactions influencing other interactions remain invisible in this kind of network illustration. We learn little about the evolving nature of the network. Thirdly, the description focuses on nodes and lines between the

nodes lifting the network out of the soil in which it grows, i.e. Star and Ruhleder's practices and other structures (1996). Therefore, the description cannot explain why these lines, i.e. connections, come about the way they do, and hardly how. From such network descriptions we cannot learn, how the socio-technical network is and becomes embedded in practices and actions.

In addition, our research design needs to account for the problem that development of II in this program involves globally dispersed actors and their activities. It resembles more what Engeström (2006) calls a mycorrhizae[2]-like form. The author uses this metaphor to describe new forms of organization of communities that are not bounded and well defined, but are the elusive, "hard to kill, but also vulnerable" base that "may lie dormant for lengthy periods of drought or cold, and then generate again vibrant, visible mushrooms when the conditions are right." Like the invisible body of a fungus, these new forms of organization can extend over large areas producing visible 'mushrooms,' for example the creation of a map, a new practice for socio-economic classification of an urban area and so forth, in few or in many widely scattered places. In other words, Engeström's mycorrhizae-like forms of organization do not eliminate visible and bounded activity systems, but they form the underlying horizontal and invisible base. These mycorrhizae are the white areas between and beyond the lines shown in figure one. The metaphor captures Star and Ruhleder's (1996) characteristic of information infrastructure as being largely invisible and "sunk into" existing practices as well as the unbounded nature of this installed base. It raises the issue of how to study not only the invisible connections in an II embedded in day-to-day practices, but how to study practices spanning across actors globally.

This 'unbounded nature' is not limited to the spatial domain. Temporarily, the visible elements, like the roles of actors and emerging actions, are also elusive and difficult to predict. In this regard Engeström (2006) speaks of the "proliferation of 'runaway objects'" referring to the increasing complexity in the objects of work leading to a loss of control. Such runaway objects start as small things: innovations, problems, may lay dormant for a long time, and suddenly break out in form of crises or breakthroughs. We can further relate this metaphor to Star and Ruhleder's (1996)

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[2] Mycorrhizae is the "invisible organic texture underneath visible fungi. … It is a symbiotic association between a fungus and the roots or rhizoids of a plant … This filamentous growth means that the fungus is in intimate contact with is surroundings … The visible mushrooms are reproductive structures… but the invisible body of the fungus, mycorrhizae, can be truly amazing" and some have been reported to cover up to 600ha with clones that germinated of a single spore 1000 years ago. (Engeström, 2006, 1787)

conceptualization of infrastructure as something that is more "when," and less "what" emphasizing the relational property of information infrastructure, where practices and language change as people become "plugged in" (p.113). This way II can be seen as something that becomes visible at some points in time in different places through practices and activities.

Our research involving actors and activities that are globally dispersed requires an approach and design that does justice to this spatially and temporarily unbounded nature of SII as socio-technical process. In the following section we outline such an approach.

4. DESIGNING AN UNBOUNDED ETHNOGRAPHY TO STUDY SII

We propose to approach this study through the tracing of action nets. The main aim of an action net approach is to show how actions are connected. According to this view actors are created through the actions they take (Lindberg, Czarniawska, 2006). This approach allows us to observe how actions and the connections between them emerge based on what is being done. In order to unearth the hidden, sunk properties of information infrastructure we will therefore focus on the study of practices of those, who become involved in the program, and the flows of information that are (explicitly or implicitly) interwoven into these practices.

These potential or existing action nets are not spatially or temporarily bounded. They may appear or disappear like Engeström's fungi in different places stretching across local, national, and continental boundaries. The researchers thus "become placed within a field of varying connections, tensions and identifications…" (Hine, 2007).

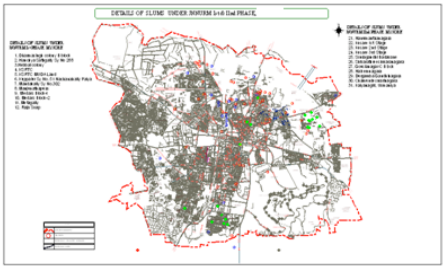
To do justice to the possible emergence of action nets in sites where global and local influences mix, and where cause and effect become entangled (Crang, 2005) we propose an unbounded ethnography combining various methods and data sources from scattered 'translocal' sites. We believe that from thick descriptions of action nets explanations emerge (see Latour, 1991), why action nets evolve in different places and times, or why not.

The concrete methods in upcoming research activities are the following: participant observation for the study of practices, actor and artifact shadowing to trace information flows, different forms of conversation from 'ordinary conversation' to 'dialogues' (Goodall, 2000) and interviews, document collection and analysis, and

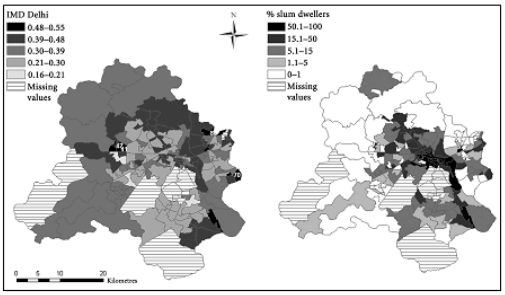
quantitative surveys. Hine (2000 in Crang, 2005) encourages the ethnographer to follow a strategy where "ethnography is as much a process of following connections as it is a period of inhabitance." Taking her advice the research design is flexible and open to allow us to follow actors and actions that promise rich insights into the emerging SII.

Figure 2: Some of the maps from various sources encountered during the first year of the research project: illustrations of visible mushrooms grown from mycorrhizae-like activities in different places at different times

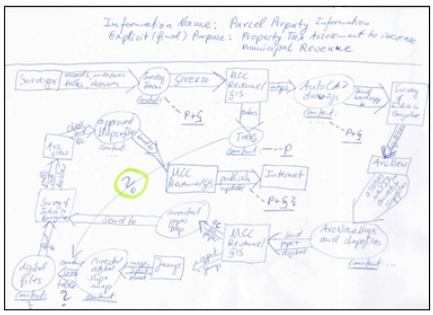
GIS generated parcel map – source: Municipal Corporation and Survey of India



AutoCAD generated map of locations of notified slums in southern Indian city – City's Division of para-statal Board



Wards with the highest poverty levels according to the Index of Multiple Deprivation (IMD) (map to the left) compared with wards with the highest percentage of inhabitants living in slums (map to the right) (in Baud et al, 2008)



Map of information flows within the GIS property tax assessment parcel mapping pilot project – source: PhD2 pilot study field notes

Indian and European researchers organize two workshops involving local and state government participants in 2009 in two Indian cities. The reparation and conduct of these workshops, the participants involved, and the program for each workshop bring together different views regarding poverty identification and alleviation practices, information use, and inter and intra-organizational relations. This "simultaneously supralocal, translocal, and local" (Cormaroff and Comaroff in

Crang, 2005) setting of the workshops opens windows and empirical entry points into evolving actions nets and information flows.

During the first workshop maps are constructed based on the participants' perceptions of different aspects of poverty and of spatial concentrations of these aspects. Comparing the construction of deprivation maps based on the Indian Census 2001 (we describe this process briefly later in the paper) with the maps of perceived concentration of deprivation obtained during the workshop gives us a first insight into the convergences and divergences of these perceptions.

For the second workshop local and para-statal administrators and practitioners from agencies involved in water supply and sanitation have been invited. The second workshop also involves mapping of perceptions, in this case the networks of inter- and intra-organizational relations and information flows or dead ends. One objective for this workshop is to identify concrete problems or specific controversial issues related to information access and sharing, and implications for the use of information in practice. We borrowed this idea from a research project in Trento, Italy, where researchers successfully identified a controversial issue in the city and used it as empirical entry point into the complex web of organizations and city management (Coletta et al, 2008). To narrow down complexity and potential workshop participants, we used word count and cluster analysis from the city's development plan and the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) reform agenda together with preliminary findings from a short pilot study in the same city to find a pressing local and state issue. From this it appears that water supply and sanitation are important issues locally. At the same time these issues are represented by means of physical capital indicators in efforts to map deprivation by research partners. Therefore, in preparations for the second workshop the water and sanitation issue served as a "boundary topic" - similar to Star's and Griesemer's (1989) boundary objects - among researchers from different organizations that are involved in this program.

Our continuing participation in workshops and their preparation, together with the collection of related documents, such as reports and maps allows us to investigate actions and information flows as they emerge not only in the Indian local context, but translocally and transnationally within the research program context.

PhD researchers on the program continue participant observation in three Indian cities after the workshops in 2009 and 2010 for a total of 15 months. Starting at the municipal engineering department we hope to gain a "zoomed in"

understanding of information flows and related work practices within and among organizations involved in water supply and sanitation. Again, through multi-sited ethnography, we will combine different methods (Crang, 2005) to follow actions and actors. "Participant observation" will include actor shadowing (surveyors, engineers) and artifact shadowing (data sets and definitions) to shed light onto practices and information flows in detail from different angles, because we do not yet know the connections between activities, use of information, individuals and organizations to describe action nets.

Because for research design we emphasize the tracing of connections as they emerge in order to create rich descriptions a strict traditional methodological differentiation between participant observation, shadowing, interviews would be illogical, even hindering.

Depending on what and how action nets emerge during the course of the study, we will conduct a social network analysis for two reasons. First, it may provide a "zoomed out" view and as such can provide insights into the larger context of individually emerging action nets. Secondly, as multi-sited ethnographers we need to "craft field sites with an eye to producing appropriate accounts for heterogeneous audiences comprising diverse sets of peers, policy makers, funders, bosses and research contacts" (Hine, 2007, 657). In other words, including a quantitative larger scale method may not only shed a different light onto the action nets of an evolving information infrastructure, but can itself be seen as an attempt "to sustain a sense of meaning in the project out of diverse responses and accountabilities" to various communities of researchers (Hine, 2007, 657) given the translocal, interdisciplinary nature of the research program. However, in line with the proposed action net approach content and recipients of a survey instrument for social network analysis depend on where the actions and objects take us during the course of the next few months.

Various documents constitute a third major source of empirical data in order to find entry to the rationales and reasons behind actions, and their changes over time. These documents include Indian state and local documents describing regulations, laws and reforms, strategic plans, and reports filed with the government related to water and sanitation, poverty programs, and information access. We have started this collection during a pilot study based on documents mentioned in interviews, encountered during office visits, and also based on what fellow researchers asked us to find for their individual work on the program. We continued with the collection of downloadable documents via web searches starting at one

Indian City Corporation's site and branching out from there via links to other state and para-statal organizations' websites. Further, for later analysis we are collecting program internal documentation, including publications by the researchers, workshop reports, and program internal communication documents.

Table one lists possible empirical data sources for the proposed unbounded ethnography of spatial information infrastructure development.

Table 1: Multi-sited empirical data sources

Empirical Data Sources for studying SII as emerging		
Activities	***Type of data source***	***Objective***
participant observation in research city in India	field notes	tracing actions that involve spatial data creation, sharing, use within the field of water supply/sanitation
actor and object shadowing in reseach city in India	field notes, information artefacts (survey forms, maps, strategic plans)	tracing actions that involve spatial data creation, sharing, use within the field of water supply/sanitation
expanding participant observation	field notes	tracing actions that involve spatial data creation, sharing, use depending on information flows beyond water/sanitation field
quantitative survey of relationships between organizations and departments	questionnaire	social network analysis for quantitative description of relations concerning limited set of topics/issues but at larger network scale
program internal documents	common publications, workshop reports, project internal communication	tracing local-global actions and information flows between
international and Indian workshops	notes, minutes, workshop output	tracing local-global actions and information flows between
team fieldwork in India	depending on type of fieldwork, field notes	tracing local-global actions and information flows between
other document review	a) Indian state and local regulations (land administration, slum policies, information management, water/sanitation related), b) Indian local	understanding background, rationale of larger context in which information flows and actions are embedded
building & development of own actor role (PhD2)	research diary, "self interview"	tracing local-global actions and information flows

5. INITIAL EMPIRICAL DATA AND FIRST LESSONS

Our perspective on spatial information infrastructure development and the proposed research design above are based on experiences from the past year's work on this program. This program provides the starting viewpoint on the fieldwork in the Indian city. That is why it is described in detail here.

In 2007 the University of Northern Europe (UNE) (all involved organizations' names have been changed) in cooperation with the Northern Indian Planning School (NIPS), the GeoTech Institute (GTI) in northern Europe, and the West Indian Social Research Institute (WSRI) started a joint program to research spatial information infrastructure development in Indian cities in support of local governance networks to tackle urban deprivations. The program builds on preceding (2003-2006) research experience in India, especially on New Forms of Urban Governance, in which UNE and NIPS were involved. The first author of this paper joined the program one year ago in April 2008, and since then has worked with European and Indian partners through meetings, workshops, and internal communications, and conducted a two week pilot study in the southern Indian city.

In the following we describe chronologically "empirical lessons" we learned from this work on the program and their relevance to the proposed study design. Specifically, we describe briefly the deprivation mapping efforts by UNE and NIPS that initiated this research program, the difficulties encountered in describing the socio-technical network initially perceived as locally bounded during a pilot study in southern India, and finally give a first glimpse into the different discourses reflected in documents authored by various (potential) actors involved.

5.1. Data and methodology

For the description of efforts to map deprivation we used two articles published by UNE and NIPS authors to briefly describe the efforts to map deprivations that led to the submission of the program's research proposal. We base the description on the main parts of the articles' own structure, i.e. reasons for the study, questions and issues to be addressed, methodology, and conclusions.

Four months after joining the program, PhD Nr. 2 (PhD2), first author of this paper, conducted a pilot study in a southern Indian city. Our "lessons learned" from the pilot study are based mainly on three transcriptions of unstructured interviews and field notes from different office visits during the two weeks. We coded the first interview with a town planner in the city to develop categories that describe the city's socio-technical network. The interviews with representatives of a para-statal board

and with a representative from the city's university, as well as field notes were then coded according to the same categories. In an attempt to find out what *potential* connections may exist we re-read the interviews several times, and finally coded them again with the following question in mind: what type of connections can we not see through the three transcribed interviews?

Finally, to get a very initial sense of dispersed ideas, actors, and actions, we also analyzed documents through frequency counts of terms (nouns only) and word clusters for these terms. Authors of the documents are those directly involved in the program as researchers, and Indian local and national government. From the latter we chose the City Development Plan (CDP) for the southern Indian pilot study city, because it was developed as part of the national JNNURM reform agenda to benefit the "urban poor," which currently drives much of the activities of project planning and implementation in the city. For this latter reason we also include the JNNURM reform agenda, an Indian national government document. The CDP is based on secondary data collected by a private agency from various local and state government, and NGO sources and thus offers a current comprehensive "story of the city." Thirdly, we include the program's research proposal, because it is the central document in discussions and meetings among researchers and basis for the PhDs individual research proposals. Also, it is a synthesis of inputs from UNE, NIPS, and GeoTech and informed by long research experience in India. Fourthly, we include the research proposal of PhD2, who is lead author of this paper, because the reflection on her own role and actions are part of the research design (unbounded ethnography) she proposes.

5.2. Initial results and first lessons learned

A major impetus to the initiation of the research program were UNE's and NIPS's efforts to investigate the spatial distribution of poverty in urban areas from the perspective of poverty as a multi-dimensional concept. We use two empirical articles published in 2008 and 2009 by UNE and NIPS about poverty mapping in Indian cities that describe part of the activities and rationales leading up to the writing of the program proposal. According to the articles, the main reason for these efforts is the need for knowledge among planners and policy makers about the nature of different deprivations in Indian cities in order to better target and implement intervention programs.

The issue specifically addressed in the articles are diversity of deprivation, their urban spatial patterns, their relation to other patterns (slum locations, voting

patterns), and in the 2009 article a comparison of these issues between three Indian cities.

Through their mapping and spatial analysis method the researchers seek to account for the multi-dimensional character of poverty and for the multiplicity in deprivations faced by households. Hence, an "Index of Multiple Deprivations" (IMD) based on 2001 Indian Census data was developed as a composite index of four capitals (social, human, financial, physical) based on Moser's (1998) asset/vulnerability framework. Each capital is made up of a set of indicators that distinguish between rich and poor. The researchers mapped IMD and individual capitals for different Indian cities by electoral wards in a Geographic Information System.

The studies show that different types of deprivation are spatially concentrated in different electoral wards in the Indian cities included in the studies, that there are areas with high overall IMD that cluster (so-called 'hotspots' of poverty), and that these areas of concentration are not necessarily coincident with official and unofficial slums (indicated by percentage of slum population per ward), an especially important finding, because many programs and organizations in India involved in poverty alleviation target slum areas only.

Specifically, the researchers suggest the use of the IMD method and GIS mapping by Indian policy-makers as well as citizens to better target and monitor poverty intervention activities. Important for this is the availability of necessary information to all stakeholders, planners, and researchers.

This process of mapping deprivation by UNE and NIPS started in 2005 when the lead researcher asked UNE's GIS specialist for the first set of Indian census data to be mapped, and in the following available census data, different spatial analyses and the visualization of spatial patterns in graphs and maps generated new questions and curiosities (personal conversation among authors of this article, 2009). This process eventually led to the formulation of a research proposal, of which this unbounded ethnography is now one part.

To address the first research objective in the program's proposal for PhD2, i.e. the description of the local socio-technical network in one Indian city, a two week pilot study was conducted in the southern Indian city. In the following, we will describe the difficulties of PhD2's attempts to describe the characteristics of a local socio-technical network based on notes and interviews from the pilot study.

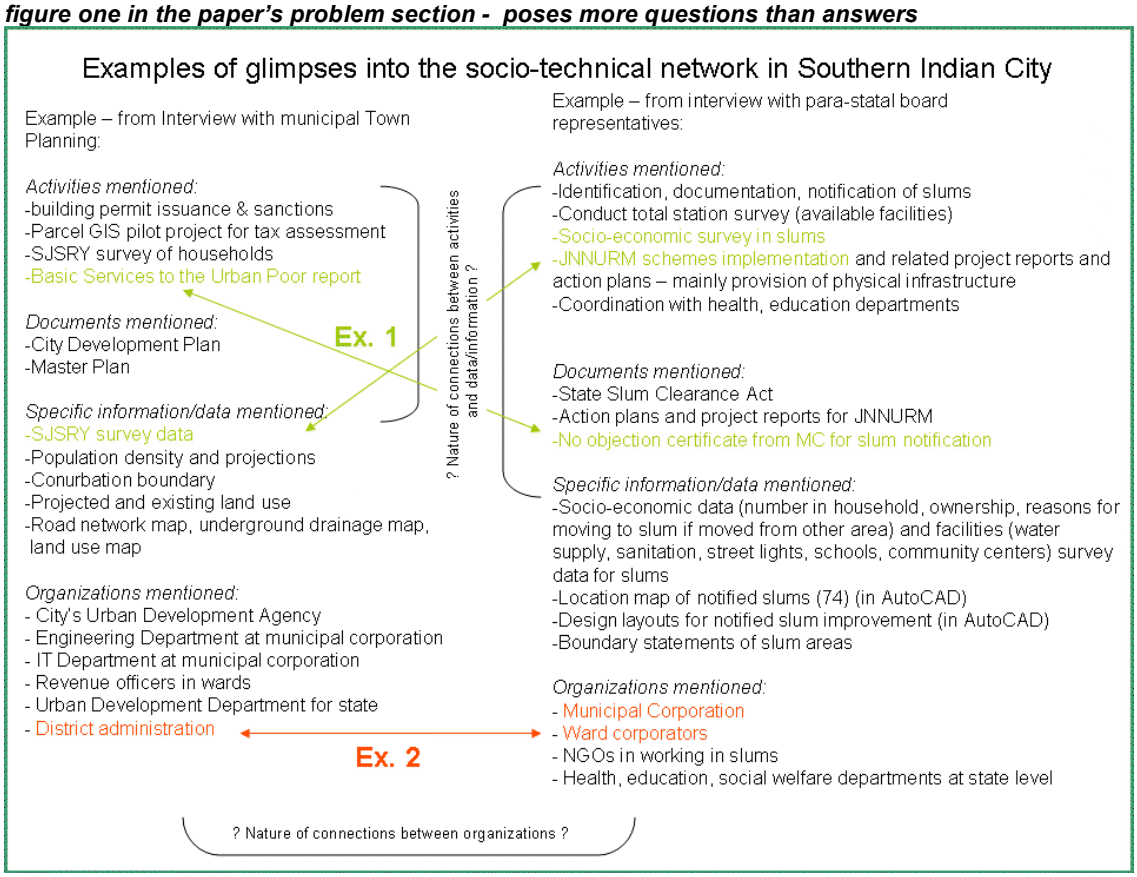
Problems and the questions that emerged from the initial visit inform the proposed research design.

The first round of coding of interviews and field notes produced the following categories to describe the existing socio-technical network: activities the organizations are currently involved in, documents mentioned, references to specific data and maps, and references to other actors and organizations. Figure three shows an example of such a tabular description of the socio-technical network. In this process it became clear, however, that connections between these elements of a socio-technical network are difficult, if not impossible, to distill from interviews. These difficulties apply to connections between activities of different organizations, but also to connections between activities and information within organizations. Many questions regarding the nature of connections on the ground remain open (see examples of such open questions below figure three).

The second round of coding brought forth four types of potential interrelated connections. As the specific characteristics of these connections remains invisible from interviews we keep them in mind for further data collection to enrich interviews.

The first type concerns connections between official activities and what is done in daily practices in a department or organization. This connection is especially difficult to learn about from interviews or surveys. While priorities and schemes to be worked on can be listed by interviewees, or in related documents, what is actually done in day to day work may be different. For example, the para-statal board (PsB) interviewee described each major scheme the organization is involved in and responsible for. But if and how each of these is tackled in practice cannot be inferred from the interview.

Figure 3*: Results from the first round of coding of pilot study interviews, which – similar to figure one in the paper's problem section - poses more questions than answers*



Example 1: Data, information, activities within and across organizations may be interwoven in one way or another. We cannot describe the nature of these connections based on interviews.

Example 2: Organizations mentioned in the interviews also cannot describe or explain the nature of the connection between municipal corporation and the para-statal board ?

The second type concerns connections between actors across and within organizations, vertically as well as horizontally. In the PsB interview coordination with other departments was emphasized by the interviewee several times. However, it remains unclear from the interview, what this coordination entails in practice and what information is shared as one interview excerpt shows:

> I1: "…apart from this we'll coordinate, true convergence"
> I2: "We'll coordinate with health department, education department. We'll ask them to come, educate them, ask them to do health check ups, things like that."
> [I1, I2 are both interviewees]

The third type involves connections between the use of spatial information and broader day-to-day activities. For example, much time appears to be spent on collecting data and filing reports to fulfill state and central government requirements, but we know little about whether and how the collected data is used. As one interviewee said

"they're asking so many details – the central government – the detailed project proposal, the details of all that – unfortunately, the city government is not able to fill out all their requirements."

In addition, while maps and geographic data are said to exist and be created, references to their use in day to day practices are scarce and usually only came up when the researcher asked specifically about them. The same interviewee mentioned that while much data exists at the corporation and also upon request from higher level government agencies, for example the national mapping organization, it is not being used, because "nobody is trained yet."

The fourth type of connection is the more abstract, but important connection between world and information, i.e. between physical features of the city and its inhabitants and the construction of issues, problems, and places in form of definitions, tables, and maps, or oral communication without material traces. The difficulty in studying this latter connection was especially apparent in questions surrounding the identification of slum areas or "pockets of urban poor." Again, an example from one of the interviews:

C: And you, or the planners, who knows where those areas are? [referring to "pockets of the urban poor" – an expression the interviewee used]

P: Actually, those slums, the slums will be notified by the district administration.

C: Ok.

P: They will identify them.

…

P: …They [urban poor people] will come and they will cluster.

C: In? Cluster, and

P: And we know those areas.

C: You know those areas. Ok.

P: We know those areas.

C: Town planning knows those areas?

P: Not town planning. We have a team to conduct the survey. Particularly we have revenue inspectors…They will know.

Table 2: Potential connection types, the nature of which remains invisible

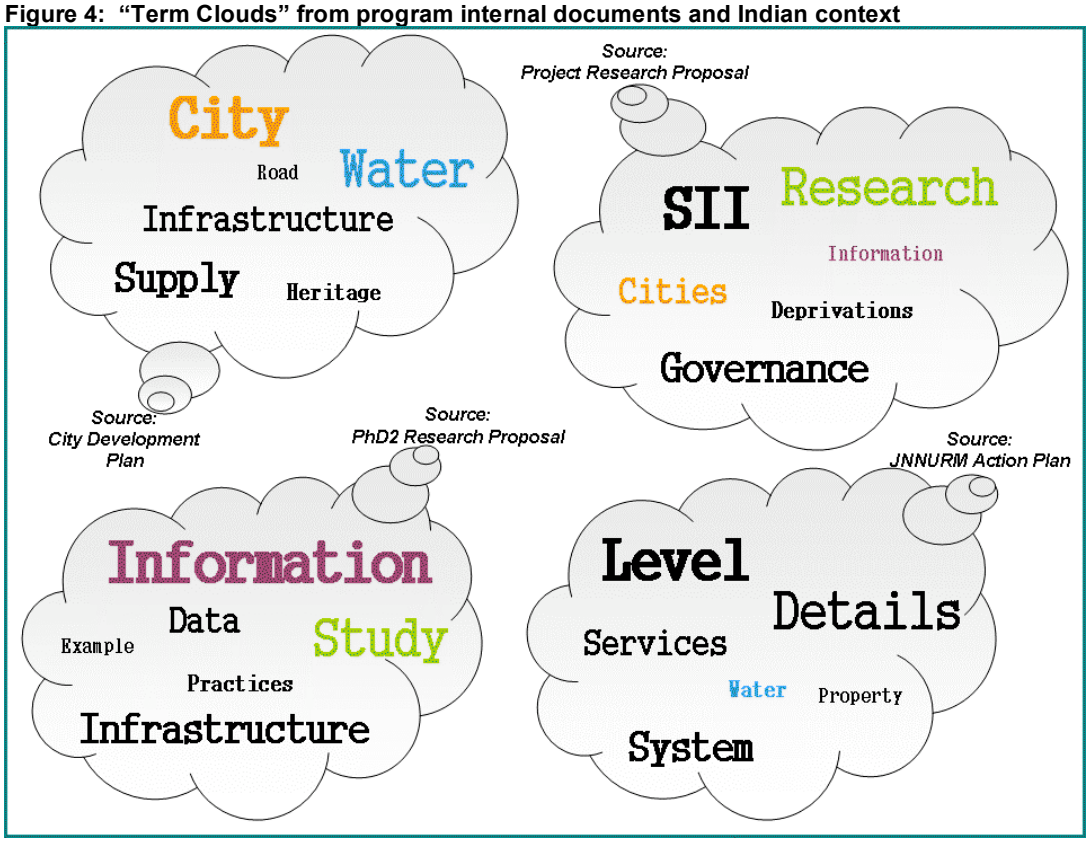
"Invisible" connection type mentioned in paper	Potential connection between …	Example for this type of connection
1	official accounts of project tasks/milestones and day-to-day activities of people in the organization	Mandatory tasks assigned to urban local bodies by central government as Basic Services to Urban Poor and what specific activities municipality departments are involved in to implement these tasks
2	organization and organization or departments within one organization	means by which municipal corporation approves of slum notification by para-statal agency (through meetings, through online or analogue forms, etc.)
3	spatial information and day-to-day activities of people in the organization	projected land use maps and if/how they are used in issuance of building permits by planning departments
4	physical world and spatial information	How - in practice - an area in the city becomes identified, defined, and officially designated a "poor area"

The purpose of this discussion based on preliminary data from pilot study interviews is not to completely describe the local socio-technical network, but to illustrate the interrelatedness of these connections, and the difficulties in understanding them through interviews alone.

From these first months in the program it became apparent that it is important to gain an understanding not only of local activities and rationales, but also those of the involved researchers in India and Europe. Throughout the study we continue to collect documents not only relevant to the Indian context, but also from the program itself. As a first step to understanding different actors' perspectives we chose four documents from research program and Indian context. Figure four shows the six most frequent nouns in each of the documents. Font size reflects relative frequency within the document, colors show similar issues or topics among documents. In combination with word clusters for these terms and pilot study interviews, we can make some preliminary observations about the views and ideas of various authors. While researchers refer to information infrastructure, Indian local and national government documents refer to physical urban infrastructure. The city's heritage and its preservation rank high on the list of terms in the CDP, because the city was selected for JNNURM funds on the basis of this criterion. The research proposal emphasizes governance networks and multiple deprivations (beyond monetary needs and physical infrastructure needs, such as roads and housing) and emphasizes the need for spatial data to map and address these issues. After reading this article it is not surprising that the term "practice" appears frequently in the PhD2 proposal.

Importantly, what we learned is that understanding the connections between "these clouds," and the arguments and histories behind them is only possible by adding further layers of information from other sources. In a first instance, these can be clusters of words around the main terms to gain context, but in a next instance we need to refer to other documents, meetings and conversations, and material outputs of activities in order to make sense of the connections between terms and actors and in order to explain rationales and arguments behind them.

Figure 4: "Term Clouds" from program internal documents and Indian context



Our proposed research design was informed by the empirical lessons in the pilot study. Broadly speaking, the three main lessons are that different types of connections and relations are hidden and cannot be described or explained through a network of lines, boxes, or clouds based on only one or two data sources. Secondly, the developing information infrastructure is not locally confined to three "research cities" in India. Thirdly, much "infrastructure happens" in the changing activities of people and things that become (visibly or invisibly) involved in the infrastructure development.

6. PRACTICAL RELEVANCE OF THE STUDY

In this last part we want to explain, why we think this view is practically relevant to the development of spatial information infrastructure in the context of this program and beyond.

Firstly, the program was initiated by the researchers, who already access the installed base, for example Indian census data and digital complaint records, for mapping and spatial analysis. Therefore, from a systems and SDI modeling point of view we are users and producers within the information infrastructure already. User requirement analysis, including existing work flows and desired outcomes of the system, is the first step in traditional information system design (for example Arlow & Neustadt 2005; Yeung & Hall, 2007). It is therefore practical to ask ourselves as well as Indian practitioners what is done and what are common goals and objectives.

Secondly, while global spatial information infrastructure development promises to support and improve decision making for sustainable development, it rests on national and regional SDI development (Nebert, 2004). One approach to such development, based on information infrastructure theory and the success of the internet, is a bottom-up approach through the cultivation of local initiatives and the step-wise institutionalization and scaling up of information, technology, and related practices (for example Sahay et al, 2006 & Georgiadou et al, 2005). But activities do not happen in local isolation, instead they involve international actors. Therefore, in order to learn what and how to institutionalize locally we need to understand the practices of those involved globally.

Thirdly, we recognize that the people involved in this program come from varying disciplinary and socio-cultural backgrounds. To work with each other, find synergies and complementarities requires for us to know what each of us is doing, seek understanding the rationales behind our activities, and their material outcomes. To focus only on what is done in India is theoretically, but also practically problematic, because the researchers' different backgrounds lead to different foci in the study. It is also problematic from a practical point of view, since an important practical consideration is the emergence of common goals, activities, and rationales among the researchers themselves and among researchers and practitioners.

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