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

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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

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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 potentia’ 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.

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 URISA1 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

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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, 2008²) 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.

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.

2.1.1. People as narrators

² Study of scale-dependency in the relationship between rainfall and vegetation data
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. 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.

2.1.2. **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.

2.1.3. **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.

2.1.4. 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.

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 socio-technical networks may form and grow through cycles of adaptation. In turn, people learn and perceive differently of socio-technical 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 socio-technical 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 socio-technical 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.

2.2.1. People as learners

People influence the trajectory of socio-technical 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).

2.2.2. People as perceivers

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

People are impacted by changes in socio-technical 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 Oojen and Nouwt, 2009).

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.

2.3.1. 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 (2007) 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).

2.3.2. 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.

2.3.3. 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.

2.3.4. 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 (Crompvoets 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).

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.

2.4.1. 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 1 from the largest to the smallest meta-class.

Table 1: Summary of implicit and explicit views on people SDI literature: classification and derived meta-classes

<table>
<thead>
<tr>
<th>Our classification of views on people in SDI literature</th>
<th>Frequency</th>
<th>%</th>
<th>Frequency</th>
<th>%</th>
<th>Meta-Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>34</td>
<td>23.9</td>
<td>91</td>
<td>64.1</td>
<td>People as elements of SDI</td>
</tr>
<tr>
<td>Members</td>
<td>20</td>
<td>14.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicators</td>
<td>16</td>
<td>11.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providers-Users</td>
<td>21</td>
<td>14.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narrators</td>
<td>3</td>
<td>2.1</td>
<td>30</td>
<td>21.1</td>
<td>People as makers of SDI</td>
</tr>
<tr>
<td>Drivers</td>
<td>16</td>
<td>11.3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Evaluators</td>
<td>6</td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human sensors</td>
<td>5</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learners</td>
<td>10</td>
<td>7.0</td>
<td></td>
<td></td>
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<tr>
<td>Perceivers</td>
<td>7</td>
<td>4.9</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Practitioners</td>
<td>4</td>
<td>2.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>142</td>
<td>100.0</td>
<td>142</td>
<td>100.0</td>
<td>Total</td>
</tr>
</tbody>
</table>
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 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 socio-technical 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 socio-technical 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 socio-technical arrangement evolves and with what consequences. From this view SDI is more open-ended, a socio-technical 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 2: Research implications for each meta-class: opportunities and risks

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

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 potential 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 socio-technical 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 SDI3, 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 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

3 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).
production in various application domains. In “Biodiversity Datadiversity” Bowker (2000) argues that the ordering of data across disciplines “lead[s] us very quickly, on the one hand, into deep historio-graphical 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 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.

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.

REFERENCES


APPENDIX: REFERENCES OF THE 158 SELECTED ARTICLES

The articles are listed in alphabetical order by first author. Those marked with * at the beginning of the citation are the 16 articles that were excluded from analysis.


Crompvoets, J. et al (Eds.). 2008. *A Multi View Framework to Assess Spatial Data Infrastructures*, Wageningen, The Netherlands, Melbourne, Australia, Space for Geo-Information (RGI), Wageningen University and Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne


