

Value of Spatial Data: Networked Performance beyond Economic Rhetoric*

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Abstract

Assessing the economic value of spatial data is problematic for various reasons – conceptual as well as operational. The paper argues that understanding the value of spatial data will benefit from the market discourse. Salient conditions for its value can be identified when spatial data are viewed in terms of market transactions rather than in terms of neoclassical economic rhetoric. Therefore, spatial data markets can best be understood as socio-technical actor networks. Moreover, spatial data are multifaceted and understood differently by different people. Space matters but differently at different spatial levels, and different decision-making contexts and styles may require different types of data and information. Hence, the paper argues that the value of spatial data is added through a complex value network rather than a sequential value chain. Consequently, the SDI-assessment discourse is particularly relevant for assessing the value of spatial data when understood as a networked performance. In conclusion, the paper recommends a deliberative, pragmatic and actor-network focus on spatial data and trans-disciplinary framing of assessing their value.

Keywords: spatial data, value network, SDI, performativity, transdisciplinary

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1. INTRODUCTION

It seems all too logic to address the issue of the economic value of spatial data because of huge (monetary) resources and interests that are allegedly associated with the rapidly expanding 'geographical information industry'. Indeed, the issue of the economic value has attracted attention of the geographical information community for some time (see for instance De Man 1989; Genovese et al. 2009b; Krek and Frank 2000; Longhorn and Blakemore 2008; Rhind 2000; for a review of literature see Genovese et al. 2009a). However, most of this research is limited to production processes – transforming spatial data (datasets or analogue maps) to 'final' products. Such a narrow instrumental view may easily overlook the complexities that generally come with the exchange of spatial data. For example, the definition of particular spatial data often helps to create a 'reality' more than to describe it. Therefore, the purpose of this paper is to contribute to the literature by adopting a broader and contextual view on the value of spatial data. Because the exchange of spatial data is generally in the interplay between multitudes of human and non-human actors, we propose an actor-network approach. From the outset it must be understood though, that the paper does not intend to offer an alternative recipe (or 'cookbook') but more a conceptual check-list supporting deliberation on what should not be overlooked in a concrete situation.

As expected, adopting a broad, contextual view on the value of spatial data is met with challenges. Assessing the value of spatial data is problematic because of their conceptual ambiguity. Besides as commodity, spatial data can also be considered as resource, asset, or even as infrastructure and relationship (see also Barr and Masser 1997; Couclelis 1997: 220). Moreover, spatial data share many of the characteristics of 'information goods' in general such as their re-usability and that they are relatively costly to produce but cheap to reproduce (see also Shapiro and Varian 1999). Assessing the value of spatial data also meets operational challenges. For instance, the value of data could depend on its use that not only can but also needs to be made of it. But what are expressed, are inevitably demands and not necessarily real needs. In addition, providing the data comes with costs. But costs are more than direct, tangible and in monetary terms. For example, the processing capacity to attend to data and information is a scarce resource (Simon 1976: 294-296). Moreover, the definition of (spatial) data and their standardization in particular, brings the risk that some phenomena cannot be adequately captured by the data (Barett et al. 2001; Rambaldi 2005; Rolland and Monteiro 2002).

The paper understands spatial data handling – their processing, exchange and distribution between their collection and use – as socio-technical practice. By this we mean an interplay between heterogeneous human and non-human actors within a social and political context (see for instance Chrisman 2005; De Man

2006; Harvey 2000; 2001; Harvey et al. 2005; Martin 2000). Reference to actors means that they perform and make the difference (Latour 2005: 154). This refers also to the emerging discourse of spatial data infrastructure (SDI) as a socio-technical actor-network. The paper also understands spatial data as performing – “doing something” – within an actor-network. In other words, spatial data are understood here as actors as well. But other actors act upon these data as well. Therefore, the value of spatial data is in their networked performance. This socio-technical actor-network view on assessing the value of spatial data may address some of the key shortcomings of the narrow instrumental view as mentioned before. But it also brings its own problems. Generally speaking, any discourse tends to be ‘performative’ in the sense that it does not only describe but simultaneously participate in the construction of reality (Callon 2007: 316; see also Ferraro et al. 2005). Consequently, the application of economic theories to the understanding of the value of spatial data can influence socio-technical practices of spatial data handling. In order to ensure that assessing the value of spatial data is beyond economic rhetoric, the paper argues that it must be ‘prudent’ (in paraphrasing Flyvbjerg 2001: 4). Assessing the value of spatial data would then be a practical, intellectual activity, aimed at clarifying problems, risks, and possibilities and contributes to the socio-technical praxis of spatial data handling.

The remainder of the paper discusses first whether the market is a fruitful concept for assessing the value of spatial data since this is central in economic discourse. The market for spatial data could then be viewed as socio-technical actor-network. This section 2 argues that the creation of market conditions will inevitably generate societal costs that come with coordination problems. The subsequent question is whether such costs are externalised or internalised in spatial data handling – crucial for assessing their value. The following section 3 explores the multi-faceted nature of spatial data and argues that value is added to spatial data through a complex network rather than a sequential chain of value-adding operations. Section 4 broadens the exploration and relates the value of spatial data to their enabling SDI. It argues that the praxis of valuing spatial data can benefit from the SDI assessment discourse – specifically from its multi-view approach drawn from a combination of different scientific traditions. Finally, the paper concludes with some brief methodological considerations for assessments that matter. It proposes an actor-network focus on spatial data, and a transdisciplinary framing of assessing their value.

2. THE MARKET FOR SPATIAL DATA AS SOCIO-TECHNICAL ACTOR-NETWORK

In this section we briefly explore the relevance of the market concept for assessing the value of spatial data. Markets are assemblies of supply and demand in the distribution of goods and services and are characterized by multi-actor competition (Beckert 2009; Fligstein 1996: 658). Neoclassical economic theory analyses the formation of an efficient distribution equilibrium via the price mechanisms of the market under assumption of fully informed and rational acting parties in the exchange processes of supply and demand (Beckert 2009: 246, 264). But the focus on prices has led to a neglect of other aspects of the economic system (Coase 1992: 714). In particular, sociological criticism of neoclassical economics accuses it of ignoring how agencies are constituted, interests are formed, incentives are managed, or resources are initially distributed (Mitchell 2007: 244). Therefore, we propose that markets should be understood as socio-technical actor-networks – socially constructed and performing – rather than as an “invisible hand out there”. The exchange and distribution of spatial data seems to be a good example of this actor-network market view.

Aspers (2009) distinguishes two (ideal) types of markets according to whether the valuation of products or services is primarily according to standards or to the status (rank) of either their producers or consumers. Therefore, this section argues first that the emerging spatial data market is moving between status and standard. Next, it argues that the complexities and transaction costs of this market are externalised rather than resolved. Finally, this section argues that that the spatial data markets can best be understood as ‘performative’ actor-networks.

2.1. Markets between Status and Standard

Markets as arenas of competition, exchange and distribution of goods and services, are sources of uncertainty and, hence, of risk. For example, limited or asymmetric distribution of information may hamper distinguishing good quality from bad quality and thereby jeopardize trade (Akerlof 1970). Such market conditions generally impose considerable search costs. Market actors need some practical knowledge to interpret their market and to operate in it – especially concerning the valuation of goods and services (Fligstein 1996: 659). Valuation could possibly be according to the standards of the commodities or the status of the actors. This leads to two ideal market types; standard and status markets (Aspers 2009). A standard market implies that the actors know the standards of the commodities which allow them to value all items traded. In a status market actors need to know about the other actors involved as this is the only basis available to them for valuing the items traded in the market (Aspers 2009: 111, 123-124).

The distinction between standard and status markets is not only analytical, but also refers to market movements from one to the other type. Fashion and branded products may be lifted out of the standard markets into a status market (Aspers 2009: 119) and traditional and personalized (status) markets may be transformed in standard markets. [A well-documented example of the latter transformation is the creation of the strawberry auction market at Fontaines-en-Sologne. Major enabling conditions were computer technology and modern management and logistic insights (Garcia-Parpet 2007).]

Exchange and distribution of spatial data typically moves between the two ideal types of status and standard markets. Because of developments in (digital) technology, economics and management practice, a tendency is clearly noticeable from an oligopolistic – or even monopolistic – market structure to a multi-actor market. This brings a tendency towards standardization as reflected in the literature on spatial data. However, at the same time branded products like Google Earth emerge thus making the market moves towards status again. But more than homogeneously swinging between these ideal types, the spatial data market may probably – and more fruitfully – be understood as heterogeneous and fragmented with different opposing trends between status and standard.

2.2. Social Construction of the Market – Externalising Complexity and Transaction Costs

This sub-section argues that markets are socially constructed through the behaviour of the market actors and at the same time shape these behaviours normatively. From a sociological point of view, markets are arenas of social interaction. This brings about a need for coordination. Generally speaking, there are coordination costs of market transactions in the exchange and distribution of goods and services – transaction costs (Coase 1992: 715; Krek 2009: 130; North 1991: 98; 1994: 361). Economizing transaction cost shifts attention from neoclassical production functions to organisation and governance structures (Williamson 1998: 32). Different problems of coordination for the market can be identified (see for instance Beckett 2009: 247, 252-261). For example, prior to the market exchange proper is the need to coordinate the value of what is traded between the actors and to establish actors' goals and preferences. The emphasis on metadata and standards in much of the literature on spatial data illustrates this point.

From these observations it follows that markets are complex socio-technical assemblies. We understand complexity as 'things relate but don't add up' and as 'more than one and less than many' (Mol and Law 2002: 2, 11). Moreover, we consider complexity as reciprocal reference – or mutuality – of individual actors instead of pre-supposing that complexity necessarily develops into stability and higher-order unity (Kwa 2002). Instead of capturing and controlling complexity,

the challenge becomes to acknowledge multiple realities shaped by different and heterogeneous reflexive actors (Hilhorst 2004).

Market transactions as the exchange and distribution of goods and services are not for free. Transaction costs can be reduced by the institutional capacity of the market. The so-called New Institutional Economics and Transaction Cost Economics in particular have addressed this issue; institutions as “rules of the game” (see for instance Coase 1992; North 1990; 1991; Williamson 1998; 2000). The rules that define relations of competition and cooperation are the governance structure of the market (Fligstein 1996: 658; Williamson 2000: 599) – its institutional capacity for societal decision making (Hajer and Wagenaar 2003: 1-12). The need to develop institutional capacity to reduce transaction costs is clearly noticeable in contemporary spatial data management. The many committees, working groups and other initiatives on standards (as for instance within the framework of the Infrastructure for Spatial Information in Europe – INSPIRE) are good examples of this point.

Markets develop as continuous, incremental processes. As human beings become increasingly interdependent the complexity of their environment increases and more complex institutional structures are necessary in solving the fundamental economic problems of scarcity. In particular institutions are being developed that permit anonymous, impersonal exchange across time and space (North 1994: 361-365; see also Williamson 1998: 24-29). We understand this incremental evolving process of market formation as trading transaction costs – because of uncertainty, complexity and risk – for the costs of creating and maintaining complex institutional and governance arrangements. An important question is who will bear the latter costs – the actors directly involved in the transactions or society at large. In other words, are these costs internalities or externalities for the market? We believe this question is crucial for assessing the value of spatial data; specifically when the discourse is increasingly dominated by privatisation and marketing.

2.3. Spatial Data Markets as Performative Actor Networks

Markets perform – “do something” (Latour 2005: 154). But at the same time, markets are socially constructed. Like so many features of economics, this duality seems so obvious that it has tended to be overlooked in discourse and theory (following Coase 1992: 713). This is especially true for the case of assessing the value of spatial data where the contemporary discourse is replete of techno-centred and positivist rhetoric (Couclelis 1997: 224; Georgiadou and Blakemore 2006). But, as this was mentioned before, discourse tends to be performative as well. Discourse not only describes but at the same time participates in the construction of social reality as the market (Callon 2007: 316; MacKenzie et al. 2007). This double helix of both market and discourse performativity challenges

the assessment of the value of spatial data because it makes the object of assessment a 'moving target'. Therefore, assessing the value of spatial data will necessitate pragmatic, heuristic and deliberative approaches beyond the application of standardized, well-defined and uniform micro-economic models. The paper comes back to this issue in section 5. Here, it may suffice to conclude that the exchange and distribution of spatial data can be fruitfully viewed in terms of market transactions and salient conditions can be identified. Our exploration so-far suggest that spatial data markets can best be understood as socio-technical actor networks where human and non-human actors are engaged in an ongoing process of mutual alignment. Finally, we should be aware that in spatial data markets – as in any other market for that matter – entrepreneurial behaviour involves some form of risk taking. Risks could be reduced to acceptable levels by anticipation rather than prediction but never can be fully resolved – how ingenious our approaches for assessing the value of spatial data might become.

3. THE COMPLEX VALUE NETWORK OF SPATIAL DATA

After having discussed the exchange and distribution of spatial data in market terms we now turn to the complex nature of the data themselves. Spatial data are complex for various reasons. For instance, they are multi-faceted and, hence, are likely understood differently by different people. At the same time they can be considered for example as a commodity, resource, asset, and infrastructure, as we have seen earlier. Moreover, spatial data handling plays a different role within different social and political contexts. This section is organised as follows. First, it argues that though spatial data is obviously about space, space matters differently at different spatial levels. Second, different decision-making contexts and styles may require different types of data and information. Third, spatial data handling may vary in quality and even may portray some kind of pathology. Finally, this section concludes that the value of spatial data is added through a complex network rather than a sequential chain of value-adding operations.

3.1. Space Matters but Differently at Different Spatial Levels

Spatial data is about space and the objects and processes therein. But space is more than a geo-referenced location. It matters for what it affords – offers, provides or furnishes (Smith and Mark 2001: 592). Therefore, space is subjectively conceived by individuals. They likely conceive space differently to the extent that space is more or less intimately connected to their behavioural experiences. This will be different at different spatial levels. (For a review of some literature supporting these arguments see also De Man 2007: 43-44) In short the argument is as follows. First, space tends to be more integrated into wholes at higher spatial levels whereas problem solving behaviour tends to be more specialized and fragmented at those levels (see also Smith 2001; Tversky 2001; 2003). An example can illustrate this point. Management of various risks – like

flooding, earthquakes, health hazards, and unemployment – seems to be integrated into livelihood at the community level, whereas these various risks are generally handled in separate ways through specialized agencies at higher levels of governance (for instance Heijmans 2004; Peters Guarín 2008). Second, space is also a setting for social life. The intensity of social encounters and social life in general – ‘social capital’ (Putnam 1995: 67) – are different at different spatial levels. Hence, space will be structured and conceived differently at these different levels. Moreover, spatial data may be interpreted differently as well. For example, housing data may be interpreted at the local level in terms of actual or desired livelihood by the household concerned but as input for policy making at higher levels of governance. Finally, space is also differentiated in private and public spheres. Boundaries of use and appropriation of public space are continuously constructed, negotiated, re-constructed, and expressed (Ünlü Yücesoy 2006). These dynamics may have a significant influence on the value of the related spatial data.

3.2. Routines and Deliberation in Spatial Decision Making

Different kinds of information will be needed for different styles of problem solving. Problems are at a continuum between well-structured and ill-structured. Regarding the well-structured problems their solutions can generally be found in a routine and programmed manner. Regarding the ill-structured problems the emphasis is on novel and heuristic decision making. Here, only vague approximations of solutions can be indicated and more effort is needed to problem finding (see also Bosman 1983; Simon 1960: 1-8). Generally speaking, well-structured problems rely on precise and well-defined models and information, whereas ill-structured problems deal with orders of magnitude. For many years the geographical information community has dealt with the question of how well-defined geographical models and tools can be applied to exploratory analysis for ill-structured spatial problems (see for instance Densham and Goodchild. 1990). Deliberative approaches to spatial decision making have emerged as a form of non-programmed decision making. They emphasize collective, pragmatic, participatory, local problem solving in recognition that many problems are simply too complicated, too contested and too unstable to allow for schematic, centralized regulation (Hajer and Wagenaar 2003: 7). It follows that different kinds of information and, consequently, different computational and visual tools are needed for routine spatial decision making and for deliberative decision making tools (see for instance Andrienko et al. 2003; Jankowski and Nyerges 2003). While for routine decision making the value of spatial data is primarily in their contribution to answering specific questions regarding spatial problems, the value of spatial data in deliberative decision making is also to trigger new and subsequent questions.

3.3. Pathology in Spatial Data Handling

Spatial data handling suffers from potential hazardous conditions in both its demand and supply side. As this was mentioned before, it seems logic that the value of data would depend on the use that needs to be made of them. But what are expressed are demands for data as subjectively perceived needs and often within their perception of what is technically possible and realistic. Consequently, there is the danger that data are supplied though on demand but not really needed. Demand for spatial data with an unnecessary level of spatial aggregation is just an example.

Possible adverse conditions are also met on the supply side of spatial data handling. More available data may bring the need to choose which data will be adopted and utilized. This puts a strain on the user's processing capacity to attend to data and information. In an information-rich environment this capacity is the scarce resource which needs to be maintained (see also Simon 1976: 294-296) – "a wealth of information creates a poverty of attention" (Simon 1969). In extreme cases, too much data and information can even frustrate the capacity to attend due to 'information overload' (see also Eppler and Mengis 2004).

3.4. Spatial Data Value Network – Economics of Redundancy

Though spatial data and geographical information are frequently used interchangeable they are obviously not the same – "geographic information is more than just data" (Couclelis 1997: 222). Data and information are often understood as an hierarchical continuum that extends to knowledge and wisdom – the 'data-information-knowledge-wisdom hierarchy' (see for instance Ackoff 1989; Nunamaker et al. 2001; Rowley 2007; and for a critical note on hierarchy Frické 2009). The economic interpretation of these transitions is conventionally in terms of a value chain (Porter 1985; see also Kaplinsky 2000) – specifically its classical, sequential form. In the context of spatial data handling, the value chain would relate to the set of value-adding operations undertaken by one or more producers, to transform datasets or analogue maps to the (final) geographical information product (Genovese et al. 2009b: 178; Krek and Frank 2000). But notwithstanding its attractiveness and merits, the linearity of classical value-chain analysis seems at odds with the complexities of spatial data handling as socio-technical actor network. In this respect, it is worth mentioning that the literature reflects an evolution of the concept from a linear, sequential value chain to an interactive value constellation (see for instance Normann and Ramírez 1993). Here, we will propose that value is added to spatial data through a complex actor-network.

Following Land (1975: 240-243), spatial data would have quality-wise increasing marginal costs and decreasing marginal value; the latter to the extent that 'overload' sets in beyond perfection (see for instance Davis and Olson 1985:

237). Thus the value curve in such cases with overload has somewhat a reversed U-shape. Assume, for example, that a map of a specific scale (say 1:50,000) is desired for some travelling purpose. A map of a much smaller scale (say 1:250,000) would not be detailed enough and a map of a much larger scale (say 1:5,000) would simply be too detailed and too many sheets would be needed likely resulting in data (and information) overload. (A similar example can be found with required pixel sizes of digital cameras.) If cost and value functions are considered simultaneously, the optimal quality of the data is generally less than what is desired because at the optimum the marginal cost equals the marginal value of the quality. In the example, a map of 1:100,000 may well be optimal when considering the cost in obtaining the map, though a map of 1:50,000 would be desired. The difference between optimal and desired (or perfect) quality level relates to efficiency in obtaining the data; is this last part of quality increase towards perfection worth the additional costs of obtaining it. This seems paradoxical at first sight. But a possible – and obvious – answer to this puzzle is that the user is able to supplement the optimal amount of information with information from other sources. For example, the (inferior) map of 1:100,000 would guide our traveller roughly to the target destiny where further, detailed directions can be asked locally.

These points could be generalized as follows. First, the need for spatial data can be met by combining different kinds of spatial data from different sources and at different costs. Different possible combinations generally imply some form of redundancy. Second, redundancy can be seen as possible condition both for efficiency and for robustness in spatial data handling as in many other fields – though within certain limits yet (see also Carlson and Doyle 2002; Landau 1969; 1973: 188; Ostrom 1999: 494, 495, 526-528; 2005: 284; Rosenhead 1980). Some redundancy can be harmful though. For example, the suppression of redundancy in data collection – the collect-it-once-use-it-many-times principle – points at possible waste of scarce resources for data collection. Spatial data handling thus involves trading differentiated redundancies – the economics of redundancy. Third, and following from the previous generalizations, value is added to spatial data through a complex network (as with the notion of ‘value constellation’; Normann and Ramírez 1993) rather than a sequential chain of value-adding operations. Within this ‘value network’ spatial data are not passive placeholders, but actors actively aligning with other human and non-human actors. In other words, spatial data are performance oriented. Therefore, we propose that the assessment of the value of spatial data is oriented towards their networked performance beyond their commodity guise.

4. SDI AS LOCUS FOR ASSESSING THE VALUE OF SPATIAL DATA

When spatial data is viewed as networked performance – or ‘performativity’ (MacKenzie et al. 2007) – the notion of SDI as socio-technical actor-network

forces itself on. Though computer technology is at the heart of SDI development it may be helpful not to confine SDI to this technology realm only – conceptually at least. Data and information always needs some form of infrastructure beyond just source and destination and regardless the technology (see also Couclelis 1997: 220). It follows that SDIs can influence the value of spatial data in two possible ways. First, a trusted SDI may reduce transaction and search costs in spatial data exchange. In the literature this issue is dealt with under the heading of the ‘institutionalisation of SDI’ (see for instance De Man 2006). Second, the assessment of the value of spatial data might be regarded as part of the wider SDI-assessment. Hence, it can benefit and learn from the SDI-assessment discourse.

4.1. Institutionalisation of SDI and the Reduction of Transaction Costs

SDI is about facilitation and coordination of the exchange, sharing, accessibility, and use of spatial data within the spatial data community with standardisation and routinisation as important functional properties. Through standardisation and routinisation spatial data handling tends to become predictable and coordinated. Thus, SDI shapes the behaviour in spatial data handling. With repetition, this behaviour tends to become a collective and objective pattern that will influence successive spatial data handling. Gradually, the structural properties of the SDI tend to become trusted and eventually institutionalised. At the same time its institutional property is shaped and reinforced by stakeholders continuously putting this patterned data handling effectively into practice – the mutual duality of both technology and institutions (see also Giddens 1984; Orlikowski 1992). It is this institutional property that contributes to the reduction of uncertainty and transaction costs as well as the search costs in spatial data handling.

4.2. Trends in SDI Assessment

Now, we now briefly discuss how valuing spatial data can benefit from the emerging SDI-assessment discourse. Although SDI assessment is still in its infancy, some trends can be identified. Approaches become more extensive, comprehensive, user-oriented, demand-driven, diverse and more closely tied to explicit targets (Crompvoets et al. 2008b: 391). SDI assessment must address the complexity and multi-faceted nature of the SDI concept as for example facilitator of communication, networked infrastructure, socio-technical actor-network, common-pool resource, and community of practice (see for instance De Man 2006). Therefore, SDI assessment needs a multi-view framework combining different approaches for each of these different facets. This framework could include approaches such as SDI-readiness, clearinghouse suitability, and INSPIRE state-of-play, (Grus et al. 2008).

Looking ahead (Crompvoets et al. 2008b: 392-396), it is likely that the SDI assessment will be governance-oriented. Conceptually at least, SDI shares the

need with governance to be flexible and adaptive yet robust and trusted. Moreover, SDI assessment will become more 'performance' focused for public management and policy. This is not a trivial issue and will bring its own challenges. From the public management domain it appears that several performance challenges (mixed responsibilities, varied objectives and the selection of indicators) and implementation problems have resulted in considerable suspicion about performance as a driver for public management (Bouckaert and Halligan 2007: 196). Nevertheless, performance praxis may well evolve in what could be referred to as 'performance governance' (: 181-195).

The interdisciplinary research project "Spatial Data Infrastructures and Public Sector Innovation in Flanders, Belgium – SPATIALIST" (Crompvoets and Bouckaert 2009; Crompvoets et al. 2008a) provides valuable suggestions for SDI assessment. For instance, a network perspective helps to characterise and underpin the assessment. The SDI performance is then described in terms of its impact on the business processes being a chain within the SDI-network (Vandenbroucke et al. 2009). SDI performance may depend on the ways how these business processes are organised and coordinated; both within and between the 'networked' organisations. These 'networked' organisations can be different in size and related to different administrative levels. One of the research questions of the SPATIALIST-project, therefore, focuses on the flexible application of standards for the different organisations at different levels. Another issue of this project addresses the legal assessment. Generally, this legal SDI-assessment could contain three levels; 1) compliance with existing legislation, 2) coherence of the legal framework, and 3) the extent of achievement of the objectives that have been set. These three levels have a different look at different elements of the SDI. Finally, the assessment of SDIs that is focused on its optimisation towards the future is problematic. This is not a trivial issue. Needed is an approach which allows for structured and profound stakeholder participation during the whole SDI decision-making process.

This brief account clearly shows the relevance of the SDI-assessment discourse for assessing the value of spatial data when understood as networked performance. Specifically, the assessment of spatial data will benefit more from a similar kind of multi-view approach drawn from a combination of different scientific traditions than from a pre-given framework.

5. VALUE OF SPATIAL DATA: NETWORKED TRANSDISCIPLINARITY

This section will briefly address some salient methodological issues for assessing the value of spatial data when understood as networked performance. First, the so-called Actor-Network Theory suggests that the assessment needs to follow closely what actors in spatial data handling actually do. Second, a transdisciplinary approach may help in addressing the paradoxes and dilemmas

that inevitably come with the assessment. Finally, an assessment 'that matters' might be satisfied with clarifying problems, risks, and possibilities and contributes to the socio-technical praxis of spatial data handling more than aiming for the application of unrealistic, law-like theories.

5.1. Actor-Network Theory: Assembling Spatial Data

Understanding the value of spatial data as networked performance finds support in the so-called Actor-Network Theory (ANT). Though ANT is not a unified body of concepts and approaches, some general consensus can be found in the literature. Actors – both human and non-human – have to do something and make a difference. Specifically, they make other actors also do things. In this sense, spatial data may well be considered as actors too, similar as, for instance, works of art. People can feel deeply attached, moved, or affected by the latter which make them feel things (Latour 2005: 236).

Actors making other actors do things is not necessarily by force or causality but by 'translation' between them (Latour 2005: 107, 108, 154, 217) – a phased process whereby the identity of actors, the possibility of interaction and the margins of manoeuvre are negotiated and delimited. It is a process, never a completed accomplishment (Callon 1986: 196, 203; 2007; see also Woolgar 1991). In other words, translation is ongoing negotiated alignment of actors into specific roles and the associated actions. Actor networks are assembled in these processes of interacting actors (Callon 1985: 24, 28, 33; Latour 2005: 169, 179). Translation signifies two things. First, actors have their own interests, beliefs and other values. Second, value conflicts are negotiated by translation and within the reality of the emerging actor network.

Translation within actor networks makes the network fundamentally susceptible for change. However, there are also several conditions for some kind of stability – or durability – within an actor network. Law (2007), for example, identifies three forms of durability; 1) the configuration of the network provides a form of material durability, 2) deliberate strategies influence translations and therefore are a form of strategic durability, and 3) besides possible change, mutual translation provides a form of discursive durability as well. The resulting durability is not a given but has to be performed. Rather than embracing too quickly preconceived theoretical and conceptual perspectives for explanation, Latour advises just to follow the trails of the actors myopically like ants (2005: 64, 108, 165-172, 176).

Following ANT, we consider spatial data as being assembled within complex actor-networks. Their value is added through the translations between the different actors. Therefore, the value of spatial data can be assessed realistically only when the interests, beliefs and other values of the individual actors are taken into account.

5.2. Transdisciplinary Framing of Assessing the Value of Spatial Data

The complexities of spatial data handling as networked performance inevitably bring conflicts and dilemmas. Though a multi-view approach will be necessary for assessing the value of spatial data, this may create its own disciplinary conflicts as well; for example, miscommunication and even conflicting 'realities' between technical and social scientists. Hence, assessing the value of spatial data will demand coordination between the different disciplines involved. Generally, coordination between disciplines is at a continuum that goes from no coordination to full coordination between the disciplines; interdisciplinarity (see for instance Max-Neef 2005; Nicolescu 2002; Tress et al. 2003). Coordination of disciplines is problematic for at least two reasons. First, each discipline has its own 'reality' and logic accordingly. Second, the knowledge that is required may exceed the sum of disciplinary knowledge in a fundamental way. This is the idea of 'transdisciplinarity' in the literature (see for instance Nicolescu 2002). Some see transdisciplinarity to indicate a kind of research that involves stakeholders who are not academics (for instance Winder 2003: 75). This does not necessarily mean that those stakeholders are member of the research team but rather that their realities and rationalities are taken into account (see for instance the research of Lawas 1997; Peters Guarín 2008). Transdisciplinarity in assessing the value of spatial data would mean that the various realities of its value network are taken seriously.

Transdisciplinarity acknowledges different levels of reality (Nicolescu 2007: 21). The notion of 'levels of reality' is significant for handling paradoxes and dilemmas as in the assessment of spatial data. For example, standardized definitions of (spatial) data bring the risk that the data cannot adequately capture some phenomena. This creates the dilemma of choosing between standardization and flexibility in the definition of spatial data. Transdisciplinarity assumes that mutually excluding opposites can be reconciled from a different level of reality (the axiom of the 'included middle' – Nicolescu 2002: 28, 29). Intuitively, transdisciplinarity is 'thinking out of the box' – specifically, out of the disciplinary box.

5.3. The Value of Spatial Data – Assessments that Matter

From the previous (sub-)sections, it follows that assessing the value of spatial data requires a truly socio-technical inquiry beyond simply bringing together paradigms of technical and social sciences, and beyond the realm of traditional positivism. Assessing the value of spatial data shares with the social sciences in general, the danger of rhetoric as well as the challenge of being relevant. Ferraro et al. (2005) argue that social science theories can become self-fulfilling by shaping institutional designs and management practices, as well as social norms and expectations about behaviour, thereby creating the behaviour they predict. Flyvbjerg (2001: 56, 57, 60-62) argues that a "social science that matters" must deliberate about values with reference to praxis and hence be pragmatic,

variable, context-dependent, and oriented toward action – prudent and of practical common sense. He offers some guidelines for such social science: focussing on values, placing power at the core of the analysis, getting close to reality, emphasizing little things, looking at practice before discourse, studying cases and contexts, asking “how?” and doing narratives, joining agency and structure, and dialoguing with a polyphony of voices (Flyvbjerg 2001: 129-140). We recommend that assessing the value of spatial data must likewise be “prudent and of practical common sense” (in this sense of Flyvbjerg) if it is to be relevant. This may balance the predominant technocratic and positivist approach of much of mainstream GI-science research.

6. CONCLUSION AND RECOMMENDATIONS ON HOW TO ASSESS THE VALUE OF SPATIAL DATA

The paper has argued that the value of spatial data is added through a complex value network. This understanding of spatial data as networked performance emphasizes the importance of the SDI-assessment discourse for assessing the value of spatial data. Specifically, the latter can benefit from a multi-view approach. We therefore recommend that the assessment of the value of spatial data is contextualised, deliberative, and pragmatic, and has both an actor-network and transdisciplinary framing. In practice, this would mean case-specific observing, interpreting and learning from performing human and non-human actors in spatial data handling within their specific contexts more than applying theories derived from general logical and methodological rules for scientific rationality *per se* (see also Flyvbjerg 2001: 33-34). In doing so, assessing the value of spatial data can benefit from a variety of scientific traditions including case-study research (Yin 1994), the use of narratives in IT evaluation (Hedman and Borell 2005; Pentland 1999), and ethnography of infrastructure (Myers 1999; Star 1999; 2002; see also Orlikowski and Baroudi 1991). It would go beyond the scope and intention of this paper to give any detailed elaboration of these traditions and we trust that their mere indication will suffice here. In short, assessing the value of spatial data is to acquire “knowledge by acquaintance with” more than just “knowledge about” as Benne et al. (1976) has put it so eloquently.

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