Assessment and socio-economic aspects of geographic information infrastructures

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Bastiaan van Loenen (Editor)

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Preface

Socio-economic aspects of geographic information (infrastructures) (GII) are increasingly considered in GII development and especially in GII research. Where once the technological dimension of GII was the dimension assessed to be most relevant, it is now commonly understood that also the non-technical aspects should be addressed and understood in order to promote GII development. There may even a trend be recognised towards a non-techical focus of GII strategies.

The socio-economic side of GII is also atracting the attention of the research community. It is evident that we are only at the beginning of the development of this loose network of those researching socio-economic GII issues (see De Man's paper). For one socio-economic aspect, the GII assessment aspect, a true loose network linking those with assessment expertise now not only shares experiences, but is also cooperatively working on the assessment issue. For other socio-economic issues such a network is still in development. One way of extending the socio-economic network is to disseminate the pool of ideas and research outcomes to speak of a true community of practice as De Man has put it.

The proceedings of the workshop on Assessment and Socio-economic Aspects of Spatial Data Infrastructures contributes to this objective. This booklet presents the outcomes of this workshop. The workshop was initiated by the OTB Research Institute of Delft University of Technology to commemorate two years of research by one of its staff members, Garfield Giff.
A selected group of academics and professionals were invited to join the workshop and to share experiences in the socio-economic frameworks within which geographic information infrastructures are emerging whether within an individual nation or across multinational regions. The contributions reflect the variery of socio-economic aspects of GII. More specifically, the presented work covers GII assessment theory, applied GII assessment, GII and eGovt, sociology and privacy.

The first paper, *Theoretical considerations for multi-view SDI assessment* by Luckasz Grus, Joep Crompvoets and Arnold Bregt, stress the importance to assess GII outcomes in order to justify the resources spent on those infrastructures. Many researchers throughout the world have been struggling with the issue of assessing GIIs. The task is difficult due to their complex, dynamic and constantly evolving nature. They argue that GIIs can be treated as a Complex Adaptive System, and therefore assessment should include strategies for evaluating those kinds of systems. They present the multi-view framework for assessing GII initiatives around the world, and argue that the strength of this assessment design lies in its flexibility, its multidisciplinary view on GII and a reduced bias in the assessment results.

Garfield Giff addresses one specific component of the multi-view framework in his paper *Using performance indicators to assess SDIs/GISs*. He discusses the need for accountability assessment of GIIs to determine their relevance and to justify financial support. Within this discussion, methodologies to facilitate this type of assessment were analysed and the decision taken that the application of Performance Indicators (PIs) to GII assessment would enhance the process. However, due to the complicated nature of a GII's performance the author concluded that there should be in place a guide to aid in the design of PIs for measure performance when conducting an accountability assessment. This guide in the form of a framework was presented and analysed within three case studies on the design of PIs for GIIs.

The theoretical papers are followed by two papers that include an actual assessment of a GII. First, Wilbert Kurvers applies in *SDI assessment from an organizational perspective* an organizational assessment methodology to the GII of the Dutch Province of Limburg and German local governments. He developed an assessment model based on GII theory, the Technology Acceptance Model and an Organisational Development Model. He distinguishes in his model the ability of organisations to implement GII and their willingness to actual do so. Twothird of the local governments in his case studies appear to be unable and unwilling to implement GII. His research outcomes suggest that the real challenges for GII implementation are at the local level.

Arif Çağdaş Aydinoğlu, Halil İbrahim İnan, and Tahsin Yomralioğlu also assess the subnational level in their paper *Examining SDI development of Turkey* as *a socio-technical approach*. They use a rainbow metaphor of GII addressing governance, literacy, provision, content, software, devices and carriageto assess the GII of the Turkish Province of Trabzon. Although there are a lot of good intentions and initiatives, they conclude that the Turkish GII requires a leader for further GII development especially to make the GII part of the Turkish e-government and information infrastructure initiatives.

Walter de Vries researches in his paper *SDI as a distant ship on the horizon of EGov* the links between research in GII and e-government. He sought empirical evidence and references for this link by comparing the important words and 'jargon' of the GII community with those within the most relevant publications in the EGov scientific community. His investigation shows considerable overlap between the two communities' wording. However, De Vries raises the question whether the presumed communalities between GII and EGov research really exist. GII and EGov implementation are addressed from different communities, different authorities and from different interests resulting very little overlap in publications and very few links between implementation strategies. This raises another question: would it be possible to merge GII and EGov research or are the two communities truly unique?

Erik de Man focuses in *Crisis in the SDI field? Or a vibrant market of ideas and initiatives between rhetoric and praxis* on the sociological aspect of GII communities. He warns for GII rhetorics leading to a misperception of reality; a collective fantasy world of GII. He wonders whether the GII field is in crisis, provided a suggested discrepancy between optimistic rhetoric and unruly reality of GII implementation. He concludes that the GIIs emerge as vibrant markets of ideas and initiatives which are far from a crisis.

The last paper by Bastiaan van Loenen (*Implications of privacy for INSPIRE and vice versa*) addresses privacy and geographic information in relation to INSPIRE. He notices that geographic information comes in many shapes and sizes and therefore privacy law may or may not apply. Generally, the higher the level of detail the more likely it is privacy law applies. The impact on INSPIRE is for a major extent depending on the outcomes of the decision on the data set specifics such as level of detail. Since these data specifications are unavailable yet, the extent to which the privacy law applies and limits the use of INSPIRE data remains unknown.

The workshop was organised by and held at Delft University of Technology on April 11, 2008. We are grateful to the Netherlands Geodetic Commission (NCG) for their willingness to publish this work that allows also others to use the experiences and research presented in the workshop to their advantage.

The editor,

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Theoretical considerations for multi-view SDI assessment[1]

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1. Introduction

Over the last few years Spatial Data Infrastructures (SDIs) have become an important issue in Geo-Information Science. Large sums of money have been invested into SDI initiatives over the last few years. Worldwide around € 120 million is spent each year just on clearinghouse management (Crompvoets, 2006). The investment requirements for an Infrastructure for Spatial Information in the European Community (INSPIRE) at European, national, regional and local levels are estimated to be in the range of € 202 to € 273 million each year (INSPIRE, 2003). Given this expenditure and society's interest in the proper and effective use of public funds, it is imperative that these SDI initiatives should be assessed (Shadish et al., 1991).

Many researchers have tried to assess SDIs (Crompvoets, 2006; Steudler et al., 2004; Rodriguez-Pabon, 2005; Delegado-Fernandez and Crompvoets, 2007; Delgado-Fernandez et al., 2005; Kok and van Loenen, 2005; Masser, 1999; Onsrud, 1998; SADL, 2005). All these attempts, however useful and valuable, either concentrate on one aspect of SDI (Crompvoets, 2006; Delegado-Fernandez et al., 2005), are bounded by one region (SADL, 2005), describe SDI development in few particular countries (Masser, 1999; Onsrud, 1998), or are still conceptual in nature (Kok and van Loenen, 2005; Rodriguez-Pabon, 2005; Steudler et al., 2004). What is needed is a multidisciplinary framework that could evaluate the full extent of SDIs worldwide.

Assessment and evaluation of SDI initiatives is problematic for a number of reasons. Even within the SDI community there are differences in the understanding of SDI and its potential benefits. Cragila and Nowak (2006) raise this issue when reporting on the key findings of the International Workshop on SDI's Cost-Benefit. They argue that there is much confusion resulting from the lack of an agreed definition of SDI, its components and the relationships between them. Moreover, different studies on SDI assessment identify different benefits and assign them to different categories (see also Grus et al. 2006a). This makes it difficult to identify uniform criteria of merit for SDI inputs, utility, outputs and

[1] This paper is a summarized version of the publication: Lukasz Grus, Joep Crompvoets, Arnold K. Bregt, 2007, Multi-view SDI Assessment Framework, International Journal of Spatial Data Infrastructure Research, Vol 2 (2007) (Available through http://ijsdir.jrc.it/).

outcomes. SDI is also difficult to assess because of its complexity and dynamic and constantly evolving nature. SDIs also differ between countries as the same implementing rules may cause different results.

In this paper we try to build a coherent SDI assessment framework that acknowledges this complexity. First we identify and analyse the key SDI characteristics that underlie the dilemmas affecting the assessment strategy. To deal with these dilemmas we examine SDI through the lens of Complex Adaptive Systems (Grus et al., 2006b). From this analysis we construct an assessment framework based on the principles of evaluating Complex Adaptive Systems (Eoyang and Berkas, 1998; Cilliers, 1998; De Man, 2006b) and evaluation theory applying to multiple-approach evaluation, using existing SDI evaluation approaches.

In section 2 we introduce the key characteristics of SDIs that influence the way in which SDI should be evaluated: multi-definitions, multi-objectives, complexity and dynamism are the issues of interest. Section 3 presents the theory of Complex Adaptive Systems (CAS) and its assessment issues, with a discussion on the issue of using multiple approach strategy in general evaluation practice. Section 4 presents the prototype evaluation framework for SDI infrastructures. The article closes with a discussion, conclusions and recommendations, especially on the potential difficulties with applying the framework.

2. SDI nature and assessment issues

Assessing SDI, especially in worldwide comparison or benchmarking studies, remains problematic. The reason for this might be the nature of SDIs, particularly their multifaceted and dynamic nature, complexity and vaguely defined objectives. Hansen (2005) stresses that the characteristics of the evaluated object determine the choice of the evaluation models. Therefore, before proposing the SDI assessment framework, it is necessary to explore these SDI characteristics in more detail to enable a justification of the choice of the assessment strategy.

SDI is defined in **multiple ways** (see, for example, Chan, 2001). The variety of ways in which SDI is defined reflects its multifaceted character (De Man, 2006). Rajabifard et al. (2002) claim that some SDIs may be treated as products while others as processes, which raises fundamental questions about SDI evaluation. To be able to assess and compare the objects of the evaluation, an agreement must be reached on single definitions of these objects and about criteria and values of merit. Referring back to Rajabifard's classification, are we assessing SDIs as products in terms of their structure or the processes they should facilitate? The criteria and values of merit may therefore depend on how we understand the SDI concept.

It can be stated that the **conceptual objective** of Spatial Data Infrastructure is to enhance access to and the sharing of spatial data produced by various agencies. The principal purpose of SDIs may be defined in different ways, for example: 'let geographic information promote economic development, improve our stewardship of natural resources, and protect the environment' (Clinton, 1994); and 'to help avoid fragmentation, gaps in availability of GI, duplication of data collection and problems of identifying, accessing or using the available data' (SADL, 2003). To allow the worldwide benchmarking of SDI, we will need uniform objectives of SDI, but the variety of interpretations of what SDIs are suggest that it will not be possible to find a single definition of SDI that everybody will agree on. This means that the framework should be able to incorporate different understandings and views of the objectives of SDIs.

During the workshop on Exploring SDI held in Wageningen in January 2006, **SDI complexity** was indicated as being one of the main obstacles and challenges to its evaluation (Grus et al., 2006a). The complexity of SDI is due to the dynamic and non-linear interactions between its entangled components. This makes it difficult to implement in diverse environments in the same way and with the same results, which in turn makes assessment difficult because of the problems of attributing success or failure of SDI implementation to one or more concrete factors. In other words, because SDIs are complex it is difficult to track cause-and-effect relationships (Rodriguez-Pabon, 2005).

The **dynamic nature** of SDI is reflected in the intensive flow of information between data producers and users (Masser, 2005). According to Rajabifard et al. (2003b) and Chan (2001) the dynamic nature of SDIs is reflected in changes in SDI technology, people and their needs. As SDI requirements and expectations change, the mediation of rights, restrictions and responsibilities between people may also change. Such changes imply that the system's behaviour is unpredictable, which presents a challenge for assessment practice. The assessment framework should allow assessment practitioners to detect and analyse the predictable as well as the unpredictable changes. Another aspect of the dynamic nature of SDI dynamism is its evolving nature. Most assessment practices measure SDIs at one moment in time, but the SDI assessment framework should also be able to describe its evolution over time, for example through longitudinal assessment approaches.

3. Towards the assessment framework

There is strong evidence that SDIs behave like Complex Adaptive Systems (CAS) (Grus et al, 2006b), and the principle of evaluating Complex Adaptive Systems (Eoyang and Berkas, 1998) underpins the design of the SDI assessment framework. Complex Adaptive Systems are open systems in which different elements interact dynamically to exchange information, self-organize and create many different feedback loops, in which relationships between causes and effects are non-linear, and where the system as a whole has emergent properties that cannot be understood by reference to the component parts (Barnes et al., 2003). Analyses of the structure and behaviour of Dutch, Australian and Polish SDIs indicate that the SDIs share the same behavioural characteristics as CAS (Grus et al., 2006b). We therefore decided to use the principles of evaluating Complex Adaptive Systems for SDI assessment. These principles specify that the framework should be flexible and have a structure that permits frequent reconsideration and redesign, because the baseline (understanding, definition, and objectives) of CAS (and also SDIs) is constantly changing. The assessment programme should concentrate on both the expected and unexpected system behaviour. It should also capture long-term and short-term outcomes, from close and distant points of view: it should contain more general, regional or cross-national comparisons (distant view) as well as more detailed case study analyses of national or local SDIs (close view). At national and regional levels, the scale of the SDI dramatically affects the amount of detail that can be accommodated in the assessment. Wider national or transnational initiatives (e.g. worldwide assessment of benchmarking) require the involvement of a much broader stakeholder network, many more assumptions (not all of which will be accepted by all stakeholders) and much less specificity than local initiatives. Because of the complex interconnections, assessment programmes should include multiple strategies and approaches, including those for linear systems, and a variety of data should be collected to reflect the variability and complexity of the system. The assessment framework should also contain methods that can capture the patterns of causal relationships. But because these patterns of causation can change in CAS (SDIs) it is essential to capture the baseline (reference point) of these causal relationships (Eoyang, 1998). For example, it may be helpful to describe the relations between the five standard SDI components (people, standards, technology, policy and data) and then observe the emergent patterns, changes and evolution of these relationships. Detailed analyses of case studies may help to reveal these interactions and rules of causation.

The recommendations for complexity assessment given above are in line with Cilliers' (1998) analysis that truly complex problems can only be investigated using complex resources. This is a reinterpretation of the antireductionist position that a complex system cannot be reduced to a collection of its basic constituencies (e.g. SDI components) – not because the system is not constituted by them, but because too much of the rational information gets lost in the process. In the same way, the SDI assessment strategy must also be complex if it is to represent the system's variability and richness in information important from the assessment perspective. Accordingly, different assessment approaches and methods must be used simultaneously (see also De Man, 2006b). The assessment framework should not try to capture and control complexity, but acknowledge multiple SDI realities shaped by heterogeneous and reflective actors. At the same time, it must be a manageable tool that contributes to a better understanding and assessment of the processes connected with SDI.

If we agree that SDIs are complex systems the discussion above implies the use of rather complex and multiple assessment approaches and methods would be a valid approach to assessing or analysing these complex systems (see Eoyang and Berkas, 1998; Cilliers, 1998; De Man, 2006b).
Assessments are made for many specific reasons, for example to measure and account for the results and efficiency of public policies and programmes, or to gain explanatory insights into social and other public problems, or to reform governments through the free flow of evaluative information (Chelimsky, 1997). Chelimsky (1997) distinguishes three general classes of evaluation purposes that cover all of the specific purposes: the accountability purpose of evaluation, the developmental purpose of evaluation, and the

knowledge purpose of evaluation. Accountability evaluation measures the results of the programme by asking cause-and-effects questions. The developmental class comprises strategies to measure and recommend changes in organizational activities and to monitor how projects are being implemented across a number of different sites. The purpose of knowledge evaluation is to generate a better explanation of the programme or to acquire a more profound understanding in some specific area or field (Chelimsky, 1997). These three classes of purposes are not mutually exclusive with regard to methods, but they may be needed at different times. For example, evaluation for knowledge or evaluation for development may be needed before evaluation for accountability. Georgiadou et al. (2006) has presented a comparable approach.

For the purpose of this paper we will use Chelimsky's three classes: accountability, knowledge and developmental, as they originate from the evaluation theorists and seem to be more generic.

4. Multi-view SDI assessment framework

The previous chapters justified the use of multiple assessment approaches, considering the multifaceted and complex nature of SDI. This section presents the assessment framework that potentially fulfils all of the requirements mentioned in the previous paragraphs. A multi-view framework is proposed in order to assess SDI. Figure 1 presents the conceptual model of the framework. The main idea behind the framework is that it covers all three purposes of assessing SDI: accountability, knowledge and development. It also acknowledges the multifaceted character of SDI.

The core of the proposed assessment framework is represented by the multiple assessment approaches that focus on different SDI aspects (facets). To overcome the problem of multiple definitions, SDI is treated here as a complex system with multiple facets. Because we concentrate here on SDI assessment, the facets are related to the assessment approaches included in the framework. Each approach treats SDI from a different view. Principally, we concentrate only on the specific objectives for each approach that SDI should meet in order to be good. For example, the Clearinghouse Approach concentrates only on the SDI's data access facility; for this approach the objectives of good SDI are related only to data access technology. The essence of the multi-view framework is that it accepts multiple views on SDI and thus accepts its complexity in terms of multiple definitions. Moreover, each approach covers at least one of the three purposes of the assessment: accountability, knowledge and development. All approaches use one or more assessment methods, such as case studies, surveys, document analysis, etc., to evaluate SDIs. The proposed assessment methods are both qualitative and quantitative.

The Generational Approach is based on the generational development of SDIs described by Rajabifard et al. (2003). The worldwide development of SDI can be measured according to the identified indicators of first, second and future generations of SDI development. The results of such an assessment will help the countries concerned to position them-

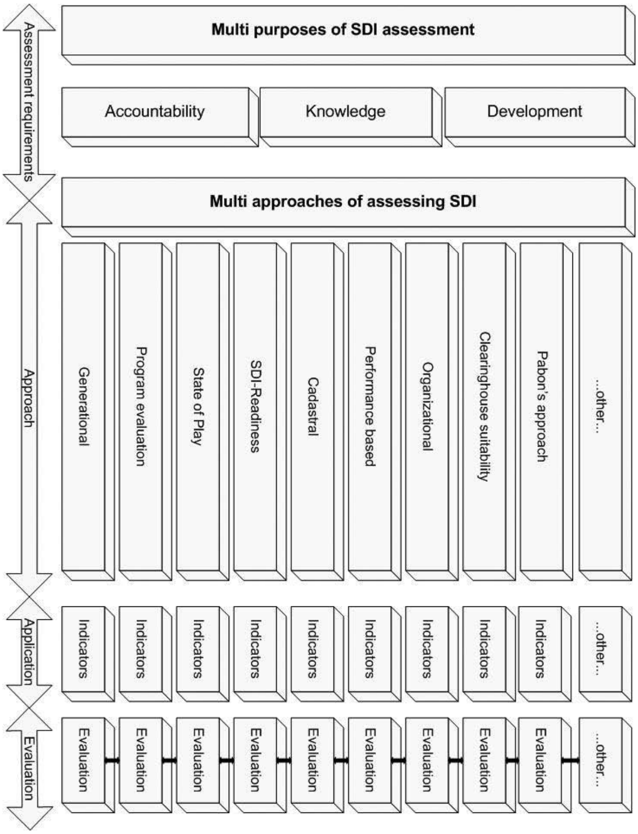

Figure 1. Multi-view SDI assessment framework.

selves on the worldwide arena and to indicate directions for future development. Moreover, iterative and longitudinal application of the Generational Approach can measure the dynamics of the worldwide development of SDI initiatives. The measurement of transitions through generations may help to capture the factors that strengthen or weaken the development of SDIs. The generational assessment approach falls into the developmental class of evaluation. It seeks to answer questions about setting a developmental agenda for SDI development, how to measure changes and to monitor SDI implementations across a number of countries. The knowledge purpose is also valid for the Generational Approach. Questions like why one SDI implementation scheme works in Europe but not in Africa may be also answered by this approach.

The basic function of Programme Evaluation is to check the accountability of social programmes launched in the education, income maintenance, housing, health and criminal justice sectors (Shadish et al., 1991). The Programme Evaluation approach can be defined as a determination of the worth of any enterprise (programme) that aims at solving a particular problem or improving some aspects of the area of interest (Worthen, 1990). This approach treats SDI as a public programme aimed at improving the access to and the sharing and usability of spatial data.

One technique for analysing programmes might be to build a logic model consisting of information on inputs, activities, outputs and outcomes. For each of these components a set of indicators can be found to assess the performance of SDIs. The Programme Evaluation approach falls into the accountability and knowledge purposes of the assessment as it answers the questions of whether the programme works and increases our knowledge about its components.

The SDI-Readiness Approach is an existing model that assesses whether a country is ready to embrace SDI development (Delegado-Fernandez et al., 2005; Delgado-Fernandez and Crompvoets, 2007). When building an SDI readiness index, various factors like organization, information, access network, people and financial resources are taken into account. Each of these factors consists of a number of indicators that can be quantitatively measured. This model falls within the knowledge and developmental evaluation purposes. The results can be used to answer questions about comparing the progress made with implementing SDIs by different countries. It also helps to identify obstacles in SDI programmes implementations. SDI-readiness is measured by collecting and analysing predefined indicators based on surveys.

The Cadastral Assessment Approach was originally developed as a land administration evaluation framework by Steudler et al. (2004). It presents a number of indicators for five areas in evaluating Land Administration Systems (LAS): the policy level, the management level, the operational level, influencing factors and assessment of performance. The reason for including this approach in the SDI assessment framework is that there are significant similarities between efficient and effective SDIs and Land Administration Systems and therefore there is a strong ground for using LAS evaluation and performance indicators for SDIs (Steudler 2003). However, this approach is still a conceptual one and has not even been used for evaluating LASs. It still needs to be developed and operationalised for application in practice. If applied it may give us answers about the performance of SDIs, as it contains a number of performance assessment indicators (accountability purpose of evaluation), and increase our knowledge about the policy, management and operational levels of SDIs (knowledge purpose of evaluation).

The Organizational (Institutional) Approach is based on Kok and van Loenen's (2005) research into the assessment of the different stages of development of geographic information infrastructures, when viewed from the institutional (organizational) perspective. This approach focuses on measuring the development of the following SDI aspects: vision, leadership, communication, self-organising ability, awareness, financial sustainability and status of delivery mechanism. This approach falls into the developmental perspective of evaluation as it measures SDI development from an organizational (institutional) perspective. So far, the authors of this approach have measured and analysed the development of five SDIs using the case study method (van Loenen, 2006).

The Performance-Based approach uses the Performance-Based Management (PBM) technique to evaluate, demonstrate and improve the performance of SDI (Giff, 2006). This approach is based on the assumption that SDI is an infrastructure and that methods like

PBM normally used for assessing the performance of infrastructure can be used for assessing SDI. This method aims at developing performance indicators based on specific SDI objectives, which are used to measure the effectiveness, efficiency and reliability of SDIs. This approach is still in the conceptual stage and specific indicators and methods to measure them have yet to be developed. It falls under the accountability evaluation purpose as it mainly seeks to answers questions about SDI efficiency and results.

The Clearinghouse Suitability Approach is based on research by Crompvoets et al. (2004) into measuring and assessing the development of National Spatial Data Clearinghouses worldwide. A method for measuring a specific set of quantitative indicators of clearinghouse portals can be applied as a continuation of longitudinal studies started in 2000. This developmental assessment aims at showing the advances and trends in the development of clearinghouses (and web portals).

The State of Play Approach is a study covering the period from mid 2002 to mid 2005 to describe, monitor and analyse activities related to National Spatial Data Infrastructures in 32 European countries: 25 EU member states, 3 Candidate Countries and 4 EFTA countries. The major activity of this study is to collect and structure all the relevant information on the status of the six building blocks that together, according to this approach, constitute an SDI: the legal framework and funding, reference data and core thematic data, metadata, access and other services, standards, and thematic environment (SADL, 2005). The same approach and methods can be used as a component of the multi-approach framework, also in regions of the world outside Europe.

Rodriguez-Pabon (2005) presents a theoretical framework to assess SDI initiatives by identifying and describing common success criteria across different contextual backgrounds. According to this framework, SDI initiatives must be evaluated in their two major dimensions: the quality dimension and virtue dimension. The quality dimension covers the efficiency and effectiveness of technical and organizational aspects of SDI projects. The virtue dimension consists of political, human and social aspects, which are measured against predefined qualitative criteria.

Table 1 summarizes the attributes of all the evaluation approaches proposed for the multi-view framework. Some of the approaches presented exist only as theoretical constructs and need to be elaborated further to develop application methods. These include the Generational, Cadastral, Performance-Based and Organizational approaches. The SDI-Readiness and Clearinghouse Suitability approaches can be applied in the framework in a straightforward manner because the methodologies and application practices already exist. The Programme Evaluation approach still needs to be developed and methods of measurement and assessment need conceptualization. This variety of assessment methods guarantees that a wide range of data on SDIs can be collected. The set of approaches constituting the framework also covers all three classes of evaluation purposes presented by Chelimsky (1997): accountability, knowledge and developmental purposes.

Approach	Goal Description	Method	Status	Assessment purpose class
Generational	To measure the development of SDIs worldwide	Survey, document study	Not developed	Developmental Knowledge
Programme Evaluation	To determine the worth and accomplishment of the objectives of SDIs	Case study and survey	Not developed	Developmental Knowledge Accountability
SDI-Readiness	To assess if the country is ready to embrace the SDI development	Survey	Applicable	Developmental Knowledge
Cadastral	To measure five evaluation areas of LAS	Survey	Needs improvement	Knowledge Accountability
Organizational	To measure SDI development from the institutional perspective	Case study	Applicable	Developmental
Performance-Based	To measure SDI effectiveness, efficiency and reliability	Not available	Needs improvement	Accountability
Clearinghouse Suitability	To measure the development and impact of SDI clearinghouses worldwide	Survey, key informants	Applicable	Developmental
State of Play	To measure the status and development of SDIs	Document study, survey, key informants	Applicable	Developmental Accountability
Pabon's	To measure quality and virtue dimensions of SDI	Case studies, Web survey	Needs improvement	Developmental, Knowledge

Table 1. Summary of evaluation approaches proposed for the multi-approach assessment framework.

5. Discussion

The core element of this paper is the presentation of the conceptual model of the SDI assessment framework. The authors intend to apply the assessment framework in their future research to assess SDIs at the national level (NSDIs). The multi-view assessment strategy was based on the principles of assessing Complex Adaptive Systems and general evaluation research. A combination of multiple approaches and methods generates more complete, more realistic and less biased assessment results. Multiple assessment methods – case studies, surveys, key informants and document studies – capture the multifaceted and complex character of SDI. They guarantee a diversity of SDI data, which in turn can reflect the complexity of the SDI. The framework is flexible because it permits evaluation approaches and indicators to be added, removed or corrected – an especially important feature when the framework is applied iteratively and refined successively. The relative complexity of the assessment framework presented here also meets the requirement that truly complex systems should be explored and understood with complex methods to properly reflect reality. The aim of the proposed framework is not only to assess SDI performance, but also to deepen our knowledge about SDI mechanisms and support SDI development.

Some obstacles and difficulties may be encountered when applying the assessment framework. The issue of timing is the first important consideration, especially in such a dynamic and constantly evolving environment like SDI. The simultaneous use of several assessment approaches will generate more realistic results than if they are conducted sequentially. Therefore the intervals between data collections for various approaches should be as short as possible to allow application of the multiple approaches to be synchronized. The next consideration is the difference in data availability between various assessment approaches and methods. Because the SDI concept is still young, some countries may not produce reports or any other data that could be used in the assessment analysis. For some assessment approaches and their methods it may be impossible to collect reliable and complete data, such as reports on SDI finances, expenditure or revenues figures, and there may be no internal self-assessment reports available. The last consideration concerns the integration of multiple approaches. The intended outcome of the integration of all the assessment approaches included in the framework is to give tangible information on the merits of the SDIs. It is possible, though, that the findings of several assessment approaches will present different pictures of SDI. These differences must be reported so that future investigators can build on such observations (Denzin, 1990).

6. Conclusions

In this paper we have highlighted four characteristics of SDI that make its assessment specific: its complexity, its many definitions, the often vague objectives and its dynamic nature. To deal with these issues we suggested that the framework should be based on the principles of assessing Complex Adaptive Systems: using multiple assessment strategies, a flexible framework and a multi-perspective view of the assessed object. We argued that the application of the proposed framework would lead to a more complete, realistic and less biased assessment of SDI. We proposed a number of existing and non-existing SDI assessment approaches as building blocks for the framework. We also discussed issues related to the application of the framework in future research. Despite the fact that the multi-approach assessment framework is strongly supported in complexity theory and evaluation practice, and its application results are promising for evaluating SDIs worldwide, we also suggest that the issues of harmonizing the different approaches at one point in time, the difficulties of collecting data for all approaches for all countries and the integration of the results should be examined critically during future application of the assessment framework.

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Using Performance Indicators to assess SDIs/GISs

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1. Introduction

In today's performance driven economies there is a great demand for conducting accountability assessment on SDI. In support of this concept, the author researched specialised techniques to assess SDIs for the purposes recapitalisation and reengineering (i.e., accountability). Specialised techniques are required for assessing SDIs within the realms of reengineering and recapitalisation because the performance of an SDI simply cannot be measured in terms of profitability or generic financial viability. In their current format, these generic tools are not generally suitable for SDI assessment because SDIs are in nature complex with monopolistic tendencies and therefore, will have complex performances (Lawrence, 1998; Rajabifard, 2002; Giff and Coleman, 2003; and De Man, 2006).

A generic methodology that may be suitably applied to an accountability assessment of an SDI is the technique – widely used in infrastructure evaluation – of assessing performance through the relationship amongst inputs, outputs and outcomes (Lawrence, 1998). This relationship can be enhanced and illustrated with the help of Performance Indicators (PIs). That is, the application of metrics to a program in order to provide performance information pertaining to its outputs, outcomes and impact with respect to its inputs and objectives. However, again, for SDI assessment these PIs must be customised to capture and represent the complex and intriguing performance of an SDI.

Exploring the above concept, further the author developed a Framework to guide the SDI community in the design of PIs specifically for SDIs. The paper presents the concept behind the development of the Framework, its implementation within a performance based management style and its application to the design of PIs for GeoConnections program.

2. The need for SDI assessment

In this paper, SDI assessment will be viewed within the context of assessment for recapitalisation and reengineering. These two areas of SDI assessment are very significant today because the majority of what Masser 1998 defined as first generation SDIs are now near their completion stage. The consequence of this fact is that these SDIs now require reengineering – and thus recapitalisation – in order to be transformed into SDIs capable of providing the quality of information demanded by current and future users. To support recapitalisation and reengineering information on efficiency and effectiveness will be required. An assessment of efficiency refers to the measuring of an SDI to determine if it is achieving its objectives in the most economical manner (input vs. output). On the other hand, an effectiveness assessment (output vs. outcome/impact) refers to the measuring of an SDI to determine if it is achieving its goals (i.e., desired outcome), along with, having the predicted impact on society.

In summary, information from an SDI accountability assessment is critical to accessing structured long-term funding in today's economic climate. This is because financiers – public and private sectors – are moving towards funding more performance-based initiatives (CMII, 1995; OAG, 1995; and PSMO, 1997). Therefore, if the next generation of SDIs are to receive any significant (structured) funding from both sectors they must be capable of measuring and reporting their level of efficiency and thus the need for performance indicators.

3. Performance Indicators

A tool that can assist the SDI/GIS community in acquiring, presenting, and reporting the performance information demanded by financiers is a performance indicator. OPM, 1990 defined Performance Indicator (PI) as the

"..... measurement of a piece of important and useful information about the performance of a program expressed as a percentage, index, rate or other comparison which is monitored at regular intervals and is compared to one or more criterion."

PIs are usually designed with respect to the organisation's goals and or objectives and can be either a quantitative or a qualitative measure (Environment Canada, 2000). This is in support of the outputs, outcomes and impacts of an organisation – in particular infrastructures – which can be either quantitative or qualitative in nature. Quantitative PIs consist of numeric values and units of measures that provide magnitude and meaning respectively (TRADE, 1995). Qualitative PIs on the other hand are usually used to measure the socio-economic performance of an organisation (e.g., user's satisfaction). However, it is quantitative information that is required by the financiers to ensure that cognitive decisions are made regarding investment (CMIIP, 1995). That is, PIs are normally required for a comparative purpose and therefore, researchers recommended that where possible quantitative values be assigned to qualitative PIs (CMIIP, 1995 and Lawrence, 1998). This is an important aspect for SDI assessment since a significant number of the outcomes and impacts of an SDI are qualitative in nature.

The following summarises key characteristics of proficient PIs (PSMO, 1997 and CHN, 2001):

- **S**pecific – Clearly defined and easy to understand.
- **M**easurable – Should be quantifiable in order to facilitate comparison with other data.
- **A**ttainable/Feasible – Practical, achievable, and cost-effective to implement.
- **R**elevant – True representation of the functions they intend to measure. Should be capable of providing factual, timely and easily understandable information about the function(s).
- **T**imely and Free of Bias – Information collected should be available within a reasonable time-frame, impartially gathered, and impartially reported.

PIs with the majority of the above characteristics (SMART) are referred to as robust, proficient indicators and are therefore more likely to be intelligible for their intended use (Audit Commission, 2000). However, in real life situations, it may be difficult to create PIs that fulfil precisely all the criteria listed above, therefore, trade-off may be necessary when designing PIs.

Although, PIs may have their drawbacks when it comes to measuring the qualitative aspect of an SDI their other useful qualities do make them applicable to SDI assessment. However, for PIs to have any significant impact on SDI assessment they ultimately must be designed based on the complexity of an SDI and not just be implanted from other industries.

4. Designing PIs for SDI assessment

The challenge to the SDI community is to design PIs capable of measuring the complicated performance of an SDI. These PIs must be capable of measuring the direct (qualitative and quantitative) performance of an SDI, as well as, the externalities derived. Consequently, PIs to assist in the comprehensive assessment of an SDI must incorporate in their design the variables that contribute and effect the complexity of an SDI's performance.

4.1. Towards a conceptual framework for designing PIs for SDIs

Working on the paradigm that designing PIs for SDI assessment is an intricate task and analyzing feedback from the community, the author concluded that there should be a guide in place to assist members of the SDI community in the design of PIs. This guide should be in the form of a framework providing clear, concise steps for the production of PIs capable of actually measuring an SDI's intricate and complicated performance.

Creating a framework of this nature will require the usance of methodologies that use clearly designed logical steps. These logical steps organised as a series of flow models are tailored to capture key functions and activities related to the purpose of the assessment (GSA, 2000). A framework of this nature is expected to be in part high-level (conceptual) and would require fine-tuning by the individual organisation before actual execution.

Applying the above theory to SDI, the author explored the hypothesis that using analogies from infrastructures and organisations producing public goods a conceptual framework for the design of PIs for SDI assessment (here after referred to as The Framework) can be formulated. Research into this hypothesis indicates that applying this concept to SDI will not be as straightforward as it is for other sectors due to the complex nature of an SDI. The research also indicated that the methodology(s) selected to be included in The Framework must be capable of encompassing knowledge of the complexity of an SDI. That is, the frameworks used in other sectors will require customisation to cope with the intricate and long-term performance of an SDI. This will ensure that the PIs produced are sensitive to the complicated performance of an SDI. Using the results of the investigation into the hypothesis as a base, the author developed a framework to aid in the design of SDI's PIs, which will be presented in the next section.

4.2. Framework outline

The Framework was developed mainly to support the design of PIs to measure the efficiency and effectiveness of an SDI. In researching design methodologies for these types of PIs, the author identifies a helpful tool (*logic model*) to assist in the design procedure. A logic model serves the purpose of connecting an organisation's activities with its performance and therefore, should be created before embarking on the actual design of PIs of this nature (Innovation Network, 2005 and Taylor-Powell, 1996). In summary, a logic model is a graphic representation of the theory of change of an organisation, so far as it illustrates the relationships with inputs, activities and results (Taylor-Powell, 1996 and Coffman, 1999). The logic model conveys these relationships through the usage of boxes, connecting lines, arrows (double directional is some cases), feedback loops, and other visual metaphors (Schmitz and Parsons, 1999) (see figure 1).

Once the logic model is completed then PIs to measure the critical success areas of an organisation – identified by the logic model – can be designed (Coffman, 1999). Applying this concept to SDI accountability assessment resulted in the identification of a minimum of three categories of PIs for this type of assessment. These three categories were formulated based on the accountability relationships amongst an SDI's inputs, outputs, outcomes, and expected impact illustrated by the logic model (see figure 1).

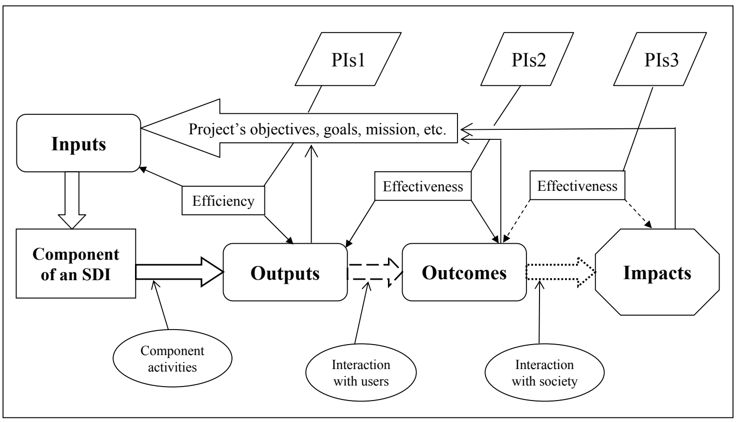

Figure 1. Example of a logic model of a component of an SDI.

From figure 1, the efficiency relationship illustrated by the logic model gives rise to a set of PIs (PIs1) to measure performance in terms of efficiency. Similarly, two sets of PIs PIs2 (output vs. outcomes) and PIs3 (outcomes vs. impacts) were identified to measure effectiveness. Analysis of a number of logic models produced for SDI assessment lends to the conclusion that a framework for the design of accountability PIs should be capable of addressing at least these three categories of PIs.

The Framework developed to assist in the design of the three categories of PIs mentioned above consists of ten fundamental steps all aimed at capturing the unique relationships amongst the inputs, outputs, outcomes, and impact of an SDI. These recommended steps are in fact nonlinear and represent iterative or circular processes that require regular revisiting. The ten customised steps in The Framework for abetting in the design of PIs for measuring the efficiency and effectiveness of an SDI are as follows:

1. Based on the objectives (program level and strategic) and the purpose of the assessment create a logic model to assist in the identification of key performance areas (i.e., critical aspects of the program to be measured).
2. With the aid of logic models identify the inputs, and the main activities/functions of the critical areas of the program.
3. Clearly define in operational and measurable terms the expected outputs, outcomes and where possible impacts. Also, in this stage decisions on milestone targets and measures can be made.
4. Identify Factors (internal and external) that are likely to influence the Outputs, Outcomes, and Impacts and therefore affect the assessment. These factors should then be encapsulated in the PIs.
5. Design a set of efficiency indicators (PIs1) based on the expected outputs. In this step, the aim is to determine whether the program is operating optimally. The PIs in this category should be capable of capturing the amount of input units that are involved in the production of a specified output. In terms of an SDI some of the challenges in developing this category of PIs are: defining inputs in monetary terms, and defining what is to be classified as output. For example, are the components of an SDI outputs or is it the datasets facilitated by the components that is the output?
6. Select key PIs from the list of efficiency PIs developed in the previous step. Again, the logic model(s) and the SMART concept can be used to assist in the selection. That is, relate the PIs to the logic model(s) to determine whether or not they are providing vital performance information pertaining to critical success areas.
7. Design a set of effectiveness indicators (PIs2 and PIs3). Effectiveness represents the influence the outputs are having on the users and to a lesser extent its impact on the wider community. For an SDI, it is expected that the PIs in this category will be more qualitative than quantitative. An example of a quantitative PI for an outcome is the percentage of users that were capable of efficiently using the datasets from the SDI in their decision-making processes. While a qualitative PI for outcome could be the level of satisfaction a user derives from the metadata provided by a data supplier. The development of PIs in this category will require extensive investigation into the

medium to long-term effects of an SDI on the society, the inclusion of a number of external variables and the possible quantification of qualitative PIs.

8. Select key PIs from the list of effectiveness PIs developed in the previous step (see step 6 for details).
9. Analyse the PIs to determine for example, if they pass the SMART test, are they cost effective to implement, data are readily available for these PIs, personnel are in place to collect and analyse the required data, and that they will be actually measuring the performances of critical success areas of the SDI.
10. Combine the sets of PIs that are capable of measuring and reporting the performance of the critical success areas (or desired areas) of the SDI.

The above Framework – ten steps – is conceptual in that it does not spell out in detail the handling of a number of the variables that affect the design of PIs and therefore will require greater analysis of variables specific to the particular SDI to be assessed before its application. That is, the application of the above ten steps to the design of PIs (in particular PIs2 and PIs3) may require the inclusion of additional variables that would facilitate the capturing of assessment features specific to the SDI in question. These variables will be predominantly external to the SDI and largely dependent on the implementation environment.

To assist in the application of The Framework the author recommends the usage of tables. Using tables to support The Framework provides the users with a schematic aide to the design process. In addition, using tables is important as they facilitate the collection and structuring of decisive information on design variables, as well as, the PIs themselves. Also, an analysis of the tables will provide PI designers with information that will enhance their ability to produce SMART PIs.

5. Application of The Framework

Although The Framework was tested within three Canadian case studies, for conciseness only a synopsis of its application to PI design for selected areas of the GeoConnections Secretariat program will be presented in the paper. GeoConnections is the Federal Government Organisation responsible for coordinating the implementation of the Canadian Geo-spatial Data Infrastructure (CGDI). GeoConnections was chosen for the examples because of the three agencies investigated it was the one with the greatest focus on using a logic model – a tool recommended by the author for the design of PIs – in their assessment activities. In addition, during the time of the case study GeoConnections was at the stage of actually designing PIs.

Analysis of The GeoConnections' logic model revealed four critical areas of the program that required assessment (i.e., User Capacity, Content, Standard and Technical Infrastructure, and Policy and Coordination). That is, the logic model indentified that these four areas were critical to the success or failure of the program and therefore, their performances should be evaluated when assessing the program. Further analysis of the logic model identified three categories of PIs to assist in the measuring of the performance of the four critical areas of the program. These three categories of PIs are similar to those identified earlier by the author (i.e., PIs1, PIs2 and PIs3) (see figure 1). Using the author's classification, for the category of PIs1 22 sets of PIs were required to assess this aspect of the program. Whilst, the requirement for the category PIs2 was 20 sets of PIs based on the 20 expected outcomes. Similarly, for the category PIs3 the GeoConnections' logic model identified the need for four sets of PIs to assist in the measuring of the performance of the expected impacts.

Based on the factors identified by the logic model the test for The Framework was to apply it to the design of 46 sets of PIs (22 outputs, 20 outcomes, and 4 impacts) for the critical areas of the GeoConnections program. Applying The Framework to this task would assist the author in determining its suitability – from an analysis of its strengths and weakness – when employed in the design of PIs of this nature. The application of The Framework – using the iterative concept – to assist in the design of PIs for the GeoConnections program was carried out as recommended using tables. The design process was divided into two segments. Firstly, efficiency PIs (PIs1) were designed by including into The Framework factors that affect the measuring of efficiency (table 1). Secondly, effectiveness PIs (PIs2 and PIs3) were designed with the inclusion of variables specific to the measuring of effectiveness levels of performance (table 2).

Variables used in the development of PIs to measure efficiency			
Goals/Objectives	**Inputs**	**Outputs**	**Efficiency PIs**
To facilitate access to good quality multi-regional integrated datasets.	Multi-level datasets with metadata, standards, web portals, access policies, etc.	Local/regional/provincial data content available through the CGDI.	1. The number eligible stakeholders from the different jurisdictions that are contributing datasets to the CGDI. 2. The number datasets from each jurisdictions available through the CGDI.
Second Iteration			
Outputs	**Stakeholders**	**Externalities**	**Efficiency PIs**
Local/regional/provincial data content available through the CGDI.	Knowledge of the stakeholder community (e.g., key data producers, type and quality of data etc.).	Knowledge of the different jurisdiction (data sharing policies, umbrella organisations, etc.).	The percentage of eligible stakeholders from the different jurisdictions that are contributing datasets to the CGDI.

Table 1. A snapshot of the activities involved in the design of efficiency PIs.

Table 1 a schema of the iterative processes involved in the application of the Framework to the design of PIs for the GeoConnections program illustrates that the initial application tracked the effects of goals, inputs, and outputs on the design of efficiency PIs. In the second iteration other influential factors are considered and the PIs refined. This procedure was repeated until the most feasible PIs are designed. Table 2 also illustrate a similar concept to that of table 1 however, in table 3, the aim was to design effectiveness PIs, and thus, factors influencing these PIs were included in the table. A similar iterative process

Variables used in the development of PIs to measure efficiency		
Outputs	**Outcomes**	**Effectiveness PIs**
Local/regional/provincial data content available through the CGDI.	Users recognize the value of regionally integrated information in addressing numerous inter-jurisdictional issues using the CGDI.	1. The number of projects using the CGDI datasets or other distributed datasets to address inter-jurisdictional issues. 2. The number of stakeholders across different jurisdictions producing datasets that facilitate integration into regional information systems. 3. The number of projects that use regionally integrated information in addressing numerous inter-jurisdictional issues.

Second Iteration			
Outcomes	**User Community**	**Externalities**	**Effectiveness PIs**
Users recognize the value of regionally integrated information in addressing numerous inter-jurisdictional issues using the CGDI.	Decision-making activities (local, regional, inter-jurisdictional), demand for inter-jurisdictional information, awareness of the CGDI etc.	Status of the supporting infrastructure, cross border sharing culture and activities, status of regional integrated information systems, etc.	1. The number of projects using the CGDI datasets or other distributed datasets to address inter-jurisdictional issues. 2. The percentage of projects that use regionally integrated information in addressing numerous inter-jurisdictional issues.

Table 2. A snapshot of the activities involved in the development of effectiveness PIs.

was applied as in table 1 with each iteration resulting in a more specific definition of the PIs.

6. Results of the application

The application of The Framework to the design of PIs for the four critical areas of the GeoConnections' program resulted in the production of SMART PIs to assist in the measuring of the programs' performance. The first iterative process produced an average of ten PIs for each activity to be assessed. At the end of subsequent iteration, the number of PIs were reduced. PIs were eliminated if the influence of one or more variables in the table renders them unverifiable or difficult to validate. The iterative process was completed when an activity had a maximum of two SMART scientifically sound PIs. On average, this feat was achieved after six iterations. An example of the final set of PIs designed for an outcome using The Framework in an iterative manner can be seen in table 3.

7. Conclusion

The paper presented the concept of assessing an SDI to justify expenditure on their implementation and to determine whether they are achieving their objectives. Within this concept, the author recommended the use of the *Performance Based Management* (PBM) style as a means to facilitate continuous and more efficient assessment of SDIs. Further exploration of this paradigm indicated that assessing an SDI requires the usage of metrics to aid in the measuring of performance. PIs were recommended as metrics to aid in the

Outcomes	Possible Performance Indicators (PI)	Data Collection Methodologies
Users recognize the value of regionally integrated information in addressing numerous inter-jurisdictional issues using the CGDI.	1. Percentage changes (-ive or +ive) in the cost of datasets for specific applications when using the services of the CGDI. 2. Percentage changes (-ive or +ive) in the time it take to acquire datasets when using the services of the technical infrastructure.	Measuring these PIs will require case studies of selected (key) stakeholders to determine how they benefit form the technical infrastructure services. This can be supported by short surveys of the wider community.

Table 3. Sample results of the application The Framework to the design of PIs for the GeoConnections program.

assessment process. The paper also concluded that the application of PIs to SDI assessment would be more effective if there was a guide in place to aid in their design.

In support of this, a Framework was developed to serve as a guide for the design of PIs for SDI assessment. Although The Framework is in part conceptual, its application in the case studies indicates that it is a suitable guide for the design of PIs for the SDIs investigated. This conclusion was based on the fact that the PIs produced in general met the requirements of the public sector funding agencies of these SDIs. The case studies also indicated that The Framework served the purpose of providing the SDI community with an insight into the steps and intricacies involved in the design of PIs for SDIs evaluation.

In concluding, the author recommends additional testing of The Framework across a wider cross-section of SDIs to determine its suitability to assist in the design of PIs for different classifications of SDIs. In addition, more in-depth studies into some of the key/common variables that contribute to the complexity in the design of PIs would greatly assist in the development of a more comprehensive Framework to act as a guide for the design of PIs to abet in the assessment of current and future SDIs.

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SDI assessment from an organizational perspective

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1. Introduction

This article is based on the M.Sc.Thesis from Wilbert Kurvers (2007), *Implementing Local Spatial Information Infrastructures: 'Are Municipalities Inspired?'*, Manchester Metropolitan University (UNIGIS).

Dutch municipalities are experiencing considerable pressure to improve the services they provide to citizens. The e-government programme (Andere Overheid, 2003), requires major efforts in the field of (GEO)ICT. New laws on the European and national level like the Åarhus Treaty [1], the directive on the Re-use of Public Sector Information [2] and the framework directive INSPIRE [3] will demand considerable efforts as well.

Are the municipalities able to cope with these changes? Municipalities are busy digitalizing and ensuring exchangeability of their spatial plans, which is obligatory within the framework of the new Spatial Planning Act (WRO, 2007). A Spatial Information Infrastructure (SDI) can add considerable value to this process (Steudler, 2003; Grant and Williamson, 2003). But are municipalities aware of the advantages of a SDI?

At this moment there are initiatives for using Spatial Information Infrastructures. In the Dutch-German border area Dutch and German governments are working together in realising a cross border Geo-information infrastructure (X-GDI, 2006). Themes like Spatial Planning, Traffic and Transport, Economic Development, Water Management, Risk Management and Environmental issues do not stop at the border and need to be managed cross boundary. The Dutch Provinces with some central municipalities are building up the infrastructure. At a later point it is intended that the smaller municipalities will join.

Research carried out by Grothe and Scholten (1996), Colijn (2000) and Peters (2003) shows that the use of Spatial Information in Dutch municipalities has increased considerably. In 2003, points out Peters, 30% of the municipalities used GIS municipality-wide and 54% mentioned working on this.

[1] Directive 2003/4/EC on public access to environmental information.

[2] Directive 2003/98/EC on the re-use of public sector information (Freedom of Information Act).

[3] Directive 2007/2/EC on INSPIRE.

Spatial Information Infrastructures (SDIs) offer a solution for granting access to spatial information (INSPIRE, 2006). Masser (2005) has made several studies of the worldwide dissemination of SDIs, by means of Rogers 'Diffusion of Innovation' model (1995). In this descriptive model, 'communication channels', communication on development, play an important role. Besides, a Spatial Data Infrastructure is mainly seen as a technically very complex matter with a major impact on the ICT environment.
From an organizational perspective, implementation of a SDI can be considered as an organizational development (Van Loenen, 2006). In this sense, organizational aspects will determine whether the municipalities are able to implement a SDI. This leads to the research question: are the municipalities willing and able to implement Spatial Information Infrastructures?

In 2008, the European INSPIRE framework directive will be turned into a national law, obliging the municipalities to implement a Spatial Information Infrastructure between 2009 and 2014 and to grant access to their spatial information. Probably, it will be difficult for small municipalities to comply with this directive (Duivenboden, 2005; Van Loenen, 2006). In the research of Duivenboden and Van Loenen, small municipalities are specifically mentioned as a target group that will probably have problems to implement SDIs. Colijn and Peters mentioned the relationship between the size of the municipality and the degree of GIS implementation. The smaller the municipality the harder it is to implement a SDI.

The municipalities covered in this study are located in the border area with Germany. The lack of up-to-date cross-border information hampers cooperation with municipalities on the other side of the border as well as economic developments in the region. Often, no information is available or there is no information on who is the owner of what information. The language barriers, the cultural differences and the differences in laws and regulations further increase the need for information.
The limited availability or usefulness of cross-border Spatial Information is among other factors the result of use barriers such as copyrights and funding, differences in the data content such as legends, data models and semantic differences (Annoni, 2000). Besides, there are differences in scale units, coordinate systems and file formats (Bulens et al., 2006). A Spatial Information Infrastructure can play an important role in this.

INSPIRE recognises the importance of ensuring access and harmonising spatial information across country borders (Annoni and Graglia, 2005). For taking adequate advantage of the value added of a SDI also across the border, it is important to know up to what extent the neighbouring German municipalities are able to grant access to Spatial-Information. Annoni and Graglia recognise isolated SDIs as a bottleneck for information exchange.

The purpose of this research was to find out whether the municipalities will have problems when implementing a SDI and, if so, based on the research results and the gained knowledge, to make recommendations so the municipalities would be better able to satisfy the demand for information exchange. Spatial Planning is the central topic covering the concrete user demand for implementation of a SDI.

2. Theoretical framework

2.1 The research models

The research question 'are municipalities willing and able to implement Spatial Information Infrastructures?' covers such a wide spectrum that different models are used to find an answer to this question.
The first model we discussed is the 'Rajabifard' model that distinguishes the components for describing a SDI. This way, the model offers the possibility of measuring the current degree of SDI implementation in the municipalities.
For examining the level of willingness, the 'Technology Acceptance Model' offers good possibilities as this model can be used to predict individual acceptance of the new technology. But willingness is not enough for also being able to implement a SDI, in which other aspects also play a role. With the organizational development model gathered from this chapter, a model is presented based on the four-phase Nolan model and the key factors for SDI implementation to determine whether the municipalities are able to implement a SDI from an organizational perspective. Because when implementing a new technology, both individual and organizational aspects play an important role.

The coherence of the three research models is reflected in figure 1. Rajabifard's model was used to determine the current implementation status, the Technology Acceptance Model measures the willingness to implement a SDI and the Organizational Development Matrix is used for determining the degree to which the municipality is able to implement the SDI.

2.2 SDI components

SDI should not be viewed as a simple entity but as a hierarchy of infrastructure models that are linked to one another through business processes. In view of this complexity and dynamic nature of SDIs, Coleman and McLaughlin (1998) argue that you can best define a SDI by describing the components. According to Rajabifard (2002) a SDI consists of five basic components: access network, policy and standards as one category and people and data as the second category. The nature of both categories is dynamic because of the changes in user groups and their needs, which also results in changes in their need and demand for data.

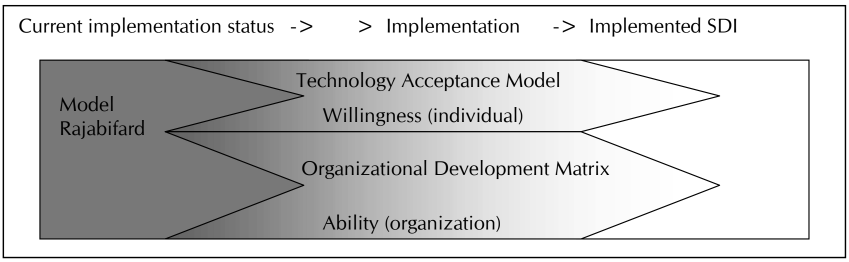

Figure 1. Coherence of the research models.

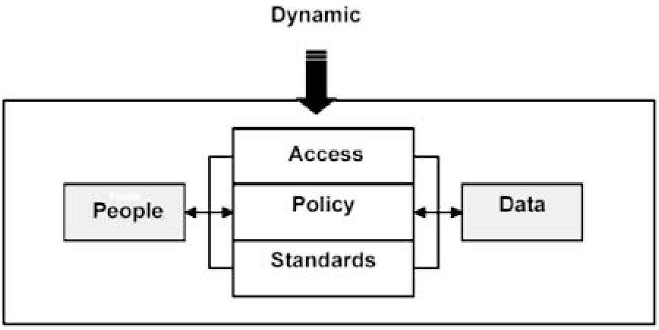

Figure 2. Relations between SDI-Components (adopted from Rajabifard et al. 2002).

Crompvoets (2006) has applied the model in his research on the worldwide development of national clearinghouses for classifying the research results. By describing a SDI on the basis of a description of the components, it becomes possible to determine the extent to which SDI components are already present or are being developed when looking at a municipality. This way, the model becomes a measurement instrument for determining the 'IST' situation of municipalities. In this sense, it is necessary to first describe the components from the theoretical framework.

People

These are all stakeholders both on the supply side and on the user side of a SDI. Rajabifard et al. (2003) underline that user needs are the driving force behind the development of a SDI. McLaughlin and Nichols (1994), as quoted by Van Loenen (2006), state that users of the SDI "will probably be the most mentioned group and yet actually the least considered".

Data

The types of datasets we distinguish in a SDI are reference data (framework datasets) and thematic data. The INSPIRE Position Paper Reference Data (2002) mentions two main ideas on which the reference data concept is based:

- It is a series of datasets used by all parties involved in geographical information for referencing their own data as part of their work. It is therefore a general basis for referencing thematic data.
- It offers a universal link between applications and hence, a mechanism for people to share knowledge and information.

The second important type of data is the thematic datasets. In a municipal SDI, not only the municipal spatial plans (zoning plans) are important, but it is also important to have access to landscape plans, environmental information and other thematic information; at the same time, a SDI enables comprehensive access in the organizations to information from multiple sources.

Metadata
Metadata is 'the information and documentation, which makes data understandable and shareable for users over time' (INSPIRE, 2003). An important aspect of data is their 'fitness for use' or quality.

Access network
Rajabifard (2002) points out that, among other things, rapid technological developments provoke quick changes in Spatial Information Infrastructures. Because of the emergence of Internet and web technology based services, technically speaking it has become easier to access information. The access network refers to portal functionality, metadata systems and the webmap servers that grant access to the geographical information using internet technology. Geo-portals, gateways to geographic content and capabilities, are a key element in SDIs, state Maguire and Longley (2005). It is a web environment in which users and suppliers can aggregate, share content and reach consensuses.
Crompvoets (2006) states that the emergence of the world wide web and web services is an important technological indicator of a new SDI phase. INSPIRE has also identified this element, which it refers to as Web services. Carrera and Ferreira (2007) mention the web service approach as the most excellent way in which municipalities can exchange information cheaply, efficiently and in a sustainable manner.

Standards
When talking about standards, we are talking about agreements on technology, data content and organization aimed at interoperability and optimisation of the SDI. For ensuring the interoperability between datasets and access mechanisms in a SDI, standards are essential (Smith and Kealy, 2003). Standardisation and harmonisation are necessary to achieve well-functioning integrated services AND lead to Integration (INSPIRE, 2002).

Policy
This is the whole of policies in relation to SDIs, with agreements on use rights and authorisations etc. According to Van Loenen (2006), policies may exist in different contexts. Some may focus on typical technological or human resource issues of a single organization, while other issues are addressed in a much broader legal or political environment, for example privacy, access to public information, or security issues.

2.3. The Technology Acceptance Model
Both Masser and Rajabifard use Rogers' Diffusion of Innovation model (1995) to describe the diffusion of Geo-Data Infrastructures. Until now the Diffusion of Innovation model (DOI) is the mostly used model for studying the diffusion of SDIs, it has two disadvantages making it less suited for this study among municipalities:

- The model describes the diffusion and acceptance of innovations on a macro level while this research takes place on a smaller-scale and more detailed level.
- The DOI is a good basis to examine the acceptance of an innovation over time; nonetheless, it is less apt for gaining a clear understanding of the acceptance on an individual level. It mainly refers to the acceptance of technology. But technologically outstanding

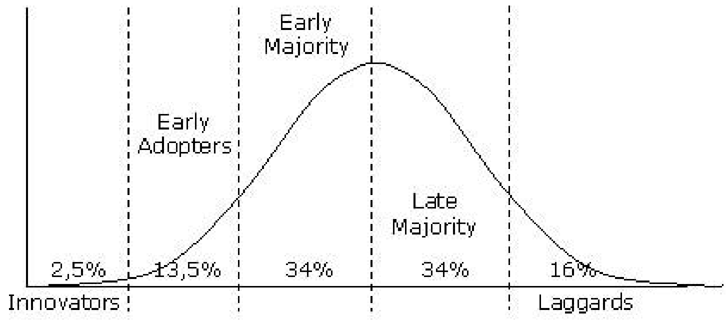

Figure 3. Adoption innovation curve (Rogers, 1995).

systems have never been a decisive factor for ensuring acceptance and use (Pijpers, 2001).

Besides the DOI model, different models are available which could be used to measure whether the municipalities are willing to implement a SDI. The Technology Acceptance Model (Davis, 1989) has proven that in the introduction, acceptance and use of ICT systems, good results are achieved for predicting and explaining users' behaviour (Pijpers et al, 2002).

The Technology Acceptance Model (TAM) was developed by Davis (1989) to predict the adoption of technology at the organizational level. The model has been used in different studies when introducing new information technologies (Pijpers, 2001). As compared to the DOI model, this model focuses less on technology and more on people's behaviour. The TAM is based on the thesis that future technology use depends on someone's behavioural intention. The behavioural intention on willingness of the municipalities is what we want to determine in this study, and the TAM seems to be an adequate model for measuring willingness.

The TAM (figure 4) shows that the Perceived Usefulness is directly affected by the Perceived Ease of Use and that the Perceived Usefulness predicts the expected Attitude Towards Use. Attitude is herein defined as the desire to start using the new technology. Attitude and Perceived Usefulness impact the intention to start using the new technology, which is a prediction of future usage or acceptance of the innovation. Perceived Usefulness is the degree to which a person believes that an innovation is better than what is currently available. In the context of a SDI, it is the degree to which the municipal user believes that the SDI has benefits or will enhance his or her performance. Perceived Ease of Use is the degree to which a person believes that using the new concept will be free of effort. In relation to the SDI this could be whether the SDI is easy to work with.

2.4. The Organizational Development Model

Masser characterises the implementation of SDIs as something that is not only of a technical nature, but also of an institutional nature. Rajabifard et al. (2003b) consider that the development of a successful SDI is a socio-technical exercise rather than a purely techni-

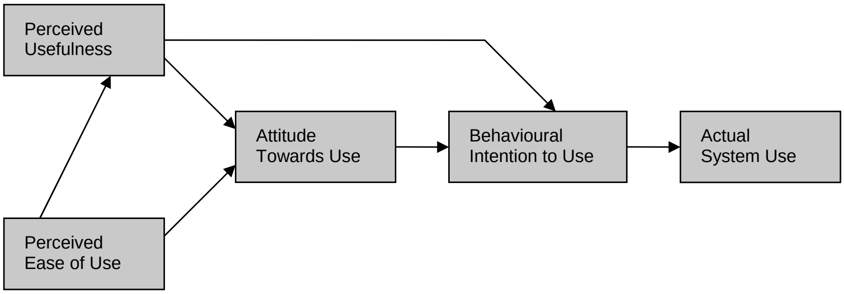

Figure 4. Technology Acceptance Model (Davis, 1989).

cal matter.Borrero (1998) even points out that the principal constraints when implementing a SDI are of an organizational rather than a technical nature.
From an organizational perspective, Nolan's four-stage model (1979) has been amply applied to define the development stage of an organization. Nolan distinguishes between four stages: initiation, expansion/contagion, formalisation or control, and finally, integration.
Different researchers have adapted the model to specific applications such as e-government development in municipalities (Layne and Lee, 2001). The Dutch Quality Institute (INK, 2003) has used the Nolan stages to develop a management model for ICT, recognising the phases of Activity, Process, System and Chain. The INK considers a fifth phase: Transformation, though this phase is in practice never achieved.

Most organization growth models are based on simple organizations such as municipalities (Graafland, 1997) but a SDI is a network organization. Van Loenen (2006) states that what is important for an individual organization is also important for a network organization. He defines four development phases or stages of a Spatial Information Infrastructure, which he calls Stand alone, Exchange, Intermediary and Network.

Based on findings of Kok and Van Loenen (2005), Van Loenen (2006) identifies six critical organization aspects for going from one stage to the next, leadership, a vision, communication channels, the strength of the GI-Community to organise itself, awareness and sustainable resources. Van Loenen clusters leadership and management's involvement. He does mention the willingness to change or culture as important factors in the phase description, but he does not include them in the matrix. Van Loenen does however add Communication Channels based on the research by Masser (2005) on SDI diffusion, in which Masser uses the Diffusion of Innovation Model.

Rajabifard and Williamson (2001) mention six key factors for speeding up SDI development, three of which are related to organization: (1) Awareness on the application of spatial information and SDI, (2) the involvement of politicians and (3) collaboration between different stakeholders.
Longhorn (2004), Graglia et al (2003) and Rajabifard et al. (2003) add that awareness also refers to the value of Spatial Information in relation to decision-making on several levels. They mention strong leadership as a complementary factor.

Verschuur and Mettau (2001) mention culture as an important organizational factor in the Spatial Planning phases. Nedović-Budić and Pinto (2000) have observed that the use of geographical information systems for spatial planning at the municipal level does not get of the ground. They mention 'People issues' as the central culprit, followed by issues such as technology and costs. Spatial Planning processes are complex, involving many organizations. Chain cooperation implies specific demands as regards the way in which parties cooperate and exchange information.

Hofstede (1997) clearly mentions that culture should not be ignored, especially on the municipal level and in view of the international context. Crompvoets (2006) adds funding as the most important factor resulting from his research. Table 1 shows the result in a development matrix from an organizational perspective.

Phase / Aspect	**Phase 1 Stand alone/ initiation**	**Phase 2 Exchange/ standardisation**	**Phase 3 Intermediate phase**	**Phase 4 Network**
A. SDI awareness/vision/clear objectives	Focus on the internal organization	Synchronisation on shared objectives	Focused on implementation of the shared objective	Shared vision Focusing on innovation
B. Leadership/ coordination	Focus on the individual	Leadership requested	Accepted leader	Shared leadership
C. Involvement management/ politics	No involvement	Management involved	Management directs development	Management actively involved
D. Culture/ willingness to change	Holding on to existing patterns	Awareness of needed changes	Clear and accepted need for change	Ample support Clear advantages
E. Collaboration	Focus on internal collaboration	Advantages of collaboration are clearly understood	Development towards network organization	Network organization
F. Funding	On an ad hoc basis	Project related	Funding assured for a certain period of time	Sustainable, passing on of costs

Table 1. Maturity of a SDI from an organizational vision.

This model is applied to determine the SDI maturity of the municipalities from an organizational perspective. Combined with the determined degree of implementation, this gives us the 'degree to which the municipalities are able' to implement a SDI.

3. Research set-up

The chosen research area is the Province of Limburg. The Province of Limburg consists of 40 municipalities. The number of inhabitants varies from 4,000 to 120,000. Considering the location of the Province of Limburg, two thirds of which borders on another country, a SDI is an important instrument, not only to exchange information with surrounding Dutch municipalities but also to strengthen cross-border cooperation based on a good information-exchange.

	Number of inhabitants 1-1-06	Number of municipalities in Limburg
Small municipalities	< 20,000	24
Medium-sized municipalities	20,000 – 50,000	11
Big municipalities	> 50,000	5

Table 2. Municipalities by number of inhabitants (CBS, 2007).

The research was also performed in the adjacent German county of Kreis Heinsberg. Given the developments of SDI in the adjacent German state North Rhine – Westphalia (GDI NRW), the SDI awareness should be higher in the German municipalities as compared to the municipalities in the Netherlands. Heinsberg is composed of 10 Gemeinden and Städte with between 9,000 and 44,000 inhabitants. However there is a difference between the Netherlands and Germany as regards administrative levels. The Kreis (County) is an additional administrative level between the municipality and the province.

The research covered 6 steps:

1. Measure the current status of SDI implementation with the aid of the SDI model of Rajabifard et al. (2002). All municipalities in Limburg and Kreis Heinsberg received a questionnaire with questions related to the SDI components distinguished by Rajabifard.
2. Inform the municipalities on what a SDI is and what this could mean for the municipalities. To avoid measuring the willingness and degree of SDI maturity while the interviewees had no idea of what SDI is, meetings were organised in which a clear explanation was given of what a SDI is and what it can mean for the municipalities.
3. Determine the willingness to implement a SDI, using the Technology Acceptance Model (Davis, 1989). For this research a questionnaire was used that could be filled out through an internet form.
4. Determine SDI maturity from an organizational perspective. A questionnaire with affirmations was developed. For each key factor, per phase different affirmations were defined that apply to that phase.
5. Process and analyse the research results. A model was developed to connect the results from the three researches to able and willing.
6. Determine whether the municipalities are willing and able to implement a SDI using the model.

One of the key factors of the matrix is the involvement and support of management and politics. We have not approached Councilors and management through questionnaires but we have interviewed them, going through the questionnaires together with the interviewee. To make clear what a SDI is a PowerPoint presentation with many pictures of applications was used. For fine-tuning the results and verifying the recommendations, interviews were also conducted with SDI & Spatial Planning experts in the field.

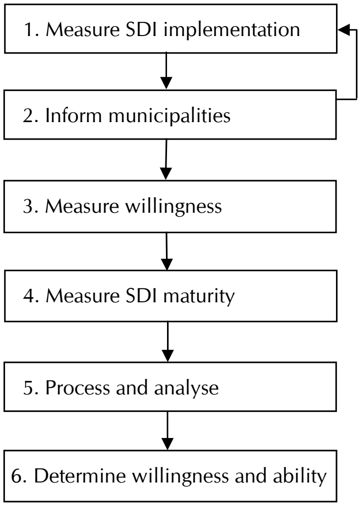

Figure 5. Research set-up.

4. Research findings

4.1 SDI implementation status in the municipalities

Below, the results of the Rajabifard (2003) model are described (briefly) per SDI component. In addition, we have mentioned the results of the additional questions related to the DURP (Digital Exchange in Spatial Processes, 2007) process.

Data

Twenty-two out of the 36 municipalities that responded have one or more digital (object-oriented) and exchangeable zoning plans, i.e. more than half of the municipalities of Limburg. When analysing the relationship between the total number of plans and the number of digitally exchangeable plans, on average 22% of the plans are digitally exchangeable.

Network

Less than half or 15 municipalities have granted access to their spatial plans on their intranet and 5 municipalities publish their plans on the internet. Twenty-one municipalities have a Mapserver.

Human resources

Twenty-six municipalities have employees with GIS knowledge. Looking at the research of Peters (2003) that concludes that 64.4% of the municipalities have a specific division or employee in charge of the set-up, implementation and maintenance of GIS applications, the 72% of municipalities that have employees with GIS knowledge is in line with the expectations.

Policy
All municipalities want to make their spatial plans available to their employees and practically all of them also want to make them available to citizens as well. Even though they wish to grant citizens access to the plans, from the information sessions and interviews it became clear that the municipalities are afraid that the provision of so much detailed information to citizens may raise questions that, in view of possible shortcomings in the plan or misinterpretations, might frustrate the plan development process.

Technology
Most municipalities, i.e. 27 out of the 36, mention that they have GIS software. The software packages vary from desktop GIS to intranet/internet viewers. The information sessions and interviews confirm that there is a limited understanding of what a Spatial Information Infrastructure is and of what technological components it is made up.

Standards
Therefore, the practically unanimous answer to the question whether the used GIS software complies with Open Standards was yes. Thirty municipalities use the content standard for the harmonisation of spatial plans.

Process
During the information sessions and interviews, it was repeatedly difficult to clearly explain what a Spatial Information Infrastructure is and in what way it can support the spatial planning process. People mainly had difficulties to imagine the way in which the own information should be made accessible and the relationship with the GIS software used in the municipality. Most municipalities said that their plans would be digital and exchangeable within the next five years.

For the Kreis Heinsberg the total score of the SDI status study shows that none of the 10 municipalities obtained the threshold for the degree of implementation.
This is because the Dutch municipalities have standardised object-oriented digital plans as a result of the DURP programme. A second reason is that many German municipalities are not willing to make their zoning plans available to citizens.

4.2 Willingness to implement a SDI (TAM)
The Technology Acceptance Model (Davis, 1989) was used for determining whether the municipalities are willing to implement a SDI. Thirty-seven respondents from 30 different municipalities assessed the affirmations of the Technology Acceptance Model (TAM), indicating the extent to which they agree or disagree with each of them. We have applied the same phrasing and scale as in Davis original research.

As regards reliability of the model the Cronbach's alpha was used to measure reliability and validity of the applied scales. This analysis based on the statistics programme SPSS showed a Cronbach's alpha of 0.91 for expected usefulness and of 0.63 for expected user friendliness. The nearer these values are to 1, the more reliable the applied scale.

The results of the five German municipalities that participated in the TAM study are consistent with the results on the Netherlands side. The score for the expected user friendliness is also lower here than the score for the expected usefulness. Four municipalities out of five are sufficiently willing to implement SDIs.

4.3 SDI maturity

The scores per key factor gives us an idea of the municipality's position, but as all factors are important, a graph is a better way to quickly assess the municipality's status and where further developments are needed. Figure 6 shows the answers of the respondents.

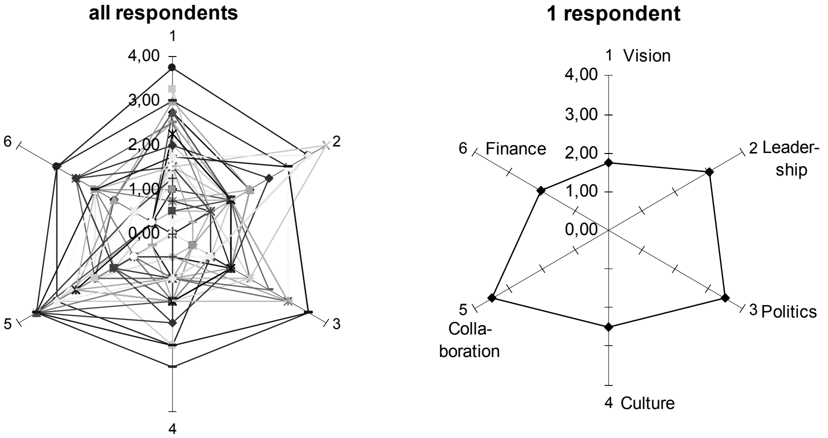

Figure 6. Organizational Development Matrix: Dutch municipalities reflected in a graph.

The graph covering all respondents shows us that the separate observations vary considerably. It is difficult to draw any further conclusions.

Of the key implementing factors, on average the highest score is assigned to the willingness to collaborate. On average, the lowest score is assigned to Funding. In his research on the development of National Spatial Data Clearinghouses, Crompvoets (2006) also found that funding was the principal obstacle for development of a SDI.

In interviews with municipal managers and directors, it became clear that they see collaboration as a possibility to gain efficiency. Smaller municipalities consider this is the only possible way to realise a SDI. All interviewed managers/councilors support the implementation of a SDI, whereby the Province is seen as the instance for coordinating this activity beyond municipal borders (leadership role).

As only five of the 10 German municipalities took part in the study, we can only reach limited conclusions. It catches the eye that the key implementing factor Funding has a very low score, null in four of the five municipalities. Also the score for political support is lower as compared to the Dutch municipalities. None of the municipalities reaches the threshold value of 2.00.

4.4 Determination of the municipalities willingness and ability to implement a SDI

Together with the results of the TAM, the position in the SDI maturity matrix shows the degree to which the municipality is able to grow towards SDI implementation starting from the current SDI status. For determining whether the municipalities are willing and able to implement a SDI, the three studies are connected as per the model shown in figure 7.

Determination of 'being willing'

When determining 'willingness', a positive TAM score means that the respondent is expected to be willing to use the development. The starting point was a value of 1 or higher, which shows that the municipalities are sufficiently motivated to implement a SDI.

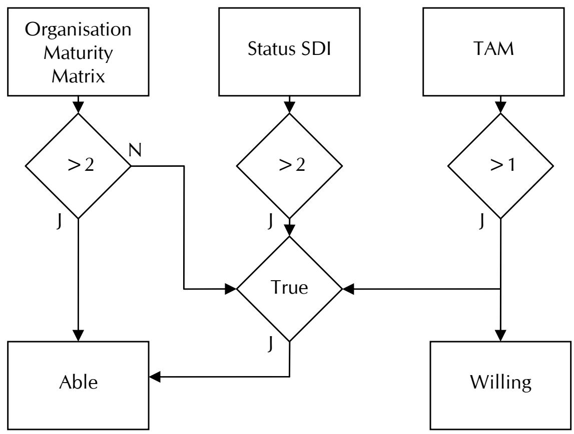

Figure 7. Model to determine willingness and ability.

Determination of 'being able'

The position in the SDI maturity matrix (organizational development matrix) shows whether the municipality is able to implement a SDI from an organizational perspective. Looking at the position of different municipalities and the experience with these municipalities, we can conclude that an average value of 2 or more is sufficient to affirm that the municipality is able to implement a SDI.

In case the value is under 2, it is important to first have a look at the found SDI implementation status. If it shows a value under 2, the municipality will not be able to implement the SDI. If it is higher than 2, than we can consider that the municipality is able to implement a SDI provided its willingness is also high.

As shown in the graph, approximately half (21) of the 40 municipalities are sufficiently willing to implement a SDI. Fifteen municipalities (38%) seem to be able to implement a SDI. Moreover, we can conclude that the scores in smaller municipalities are lower as compared to the bigger ones. The four municipalities that did not respond and for which it is not possible to make an assessment based on the other studies are all, but one small municipalities. As expected, these municipalities cannot be considered as being able to implement a SDI.

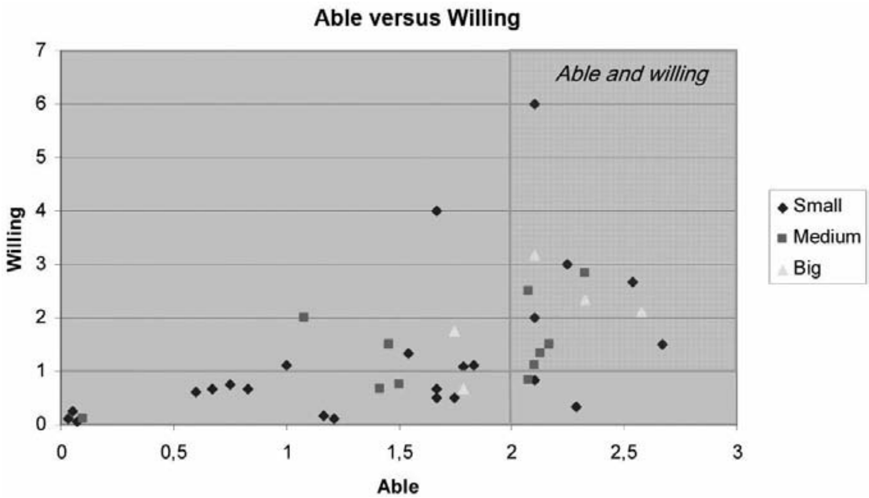

Figure 8. Graph on 'willingness' and 'ability' of the municipalities of Limburg.

As a result of the studies and the used model, we see that 13 municipalities or around one third are both willing and able to implement a SDI. Consequently, 27 of the 40 municipalities, i.e. two thirds are either unwilling or unable to implement a SDI!

Having a closer look at the values of the three studies, we see in many cases similar values in the SDI implementation status, the Organizational Development Matrix (ODM) and the TAM. In other words, if the score of the SDI status is low or high, then in most cases the score in the other two studies will also be low or high. This is in keeping with the assessment made on beforehand that the measured SDI implementation status is an objective confirmation of the position in the SDI maturity matrix.

Four of the five municipalities in Kreis Heinsberg that participated in the web study are willing to implement a SDI. In view of the score under 2.00 both in the organizational development matrix and the SDI implementing status, none of the ten municipalities can be considered as being able to implement a SDI.

5. Conclusion and recommendations

5.1 Conclusion

Spatial Information Infrastructures (SDIs) are complex and in Rajabifard's opinion (2003) they can best be explained by describing the different components. Through this component-based model it was possible to make an inventory per component of the progress made by the studied municipality in implementation of a SDI. At the same time, the SDI Organizational Development Matrix developed during this study turned out to be a good method to measure the SDI maturity of the studied municipalities from an organizational perspective based on the key SDI implementation aspects.

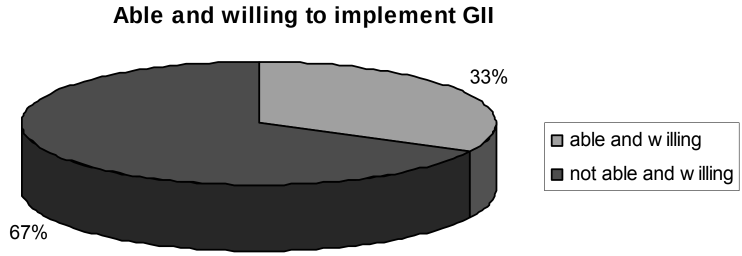

Figure 9. Number of municipalities in Limburg that are wiling and able to implement SDIs.

Thirdly, the Davis' Technology Acceptance Model (1989) showed that the municipalities have a clear understanding of the personal usefulness of a SDI, they have more difficulties to imagine the user friendliness of these infrastructures. The expected usefulness and user friendliness together predict the expected use and hence the personal implementation willingness.

Based on the inventory of the current SDI implementation status in the municipalities, the measurement of the willingness to implement SDIs and the determination of SDI maturity from an organizational perspective, it was found that around half (21) of the 40 municipalities in Limburg are willing to implement a SDI and slightly over one third (15) is also considered able to do so. Approximately one third (13) of the municipalities is both willing and able to implement a SDI.
Based on these results, we can conclude that the municipalities in Limburg (as a whole) are not willing and able to implement SDIs (at the moment this research took place).

Looking at the degree of implementation, we see important differences. When considering all SDI components separately, especially the smaller municipalities have not yet made a lot of progress and despite the imminent legal obligations, some have not even planned any developments so far.

Also in terms of SDI maturity from an organizational perspective, the smaller municipalities' score is lower than that of the bigger ones. Despite the significant diversity of the positions in the organizational development matrix per key factor, the average score was between 1 and 2, with the lowest score for funding. Crompvoets (2006) already pointed out that funding was a bottleneck in SDI development.
On average, collaboration occupied the highest position in the matrix. The municipalities consider that collaboration is the way by excellence for taking advantage of developments with a minimum own effort. Some municipalities said they were already involved in collaboration links in the field of Spatial-Information.

One of the causes explaining the lack of sufficient willingness to implement a SDI is that there is too little information on what a SDI is and what it could mean for the municipalities. It is the smaller municipalities that are not willing or able to implement SDIs. The fact

that the municipalities that did not react are in general small municipalities confirms this idea. The response showed that the bigger the municipality, the higher the response.
A positive factor is that the small municipalities consider that collaboration is a possibility to comply with the requirements. Besides, the smaller municipalities seem to be more flexible and might therefore be able to more quickly implement a SDI as compared to the big ones. The bigger municipalities often operate in silos (van Duivenboden et al., 2005).

In the organizational development matrix, the score assigned to funding was significantly lower for the German Municipalities as compared to the Dutch ones. This is one of the factors why none of the five municipalities that filled out the web form is able to implement a SDI, though four out of the five were willing to do so.
Looking at the current implementation status, the lack of digital object-oriented spatial plans and the policy for granting citizen access to these plans turned out to be structurally different from the Dutch municipalities. Based on the measured implementation status, we can consider that none of the ten municipalities is able to implement a SDI.

5.2 Solution directions for the municipalities

Implementing a SDI is not something that can be done from one day to the next and begins with communication on the value added of a SDI for the municipalities. This both at the level of Spatial Planning, Geo and ICT employees and at the level of the municipal management and government. In the meetings with municipalities and councillors, it was clear that showing examples of SDIs is extremely important.
Other necessary factors are coordination and leadership to focus the implementation process from a perspective that goes beyond the municipal level. The interviewed councillors pointed out that the Province/Kreis/Bezirk is the most adequate level for assuming this role. Agreements at the governmental level are also needed to ensure the exchange of information and enable chain collaboration.
A service-oriented architecture is a requirement for meeting the e-government obligations, which implies that the implementation of a SDI becomes easier technically speaking. Funding is a crucial factor and resources are needed to implement a SDI. The research has shown that even though funding is considered a problem, money can always be made available for good projects. This was confirmed in the interviews. Also collaboration and the use of European structure funds (Interreg, 2007) were mentioned as possibilities for limiting this problem.
We found that mainly the smaller municipalities lack knowledge and experience with SDIs. One way to compensate this drawback is make use of a shared service centre or by taking advantage of the infrastructure of a big municipality. An improved collaboration is the best way to enhance the municipalities' ability to implement a SDI.

5.3 INSPIRE recommendations

Ongoing communication with the municipalities is needed from INSPIRE. Masser (2007) refers to this as networking which he considers is a 'social learning process'. In this sense, it is important that it is not only clearly explained to the municipalities that they will be obliged to harmonise and grant access to the information in keeping with the implementation rules, but rather that they are made to understand this need. Only if and when the municipalities themselves see the advantages, they will cooperate in the implementation.

Funding turned out to be the principal bottleneck in SDI implementation: invest in local developments. Central and local developments must run in a parallel manner rather than consecutively. Central facilities are not the solution in this. The policy officer or spatial planner must be able to use the available information in his workplace in his own application combined with local information. This is the best way to support work processes and chain collaboration.

The municipalities cannot do this alone and collaboration is the manner by excellence to implement a SDI. Foment collaboration and invest in knowledge to adequately advise the municipalities. Use the governmental layer beyond the municipal level with expertise in the field of SDI that knows the municipalities and can play a coordinating role in the implementation, e.g. Provinces (the Netherlands), Kreisen and Bezirken (Germany). Because of the differences between the administrative levels in the EU the responsibility for implementation on the local level has to be covered well.

Furthermore, examples are needed of functioning SDIs focusing on policy content issues. In this way, it can be possible to obtain both official and political support for implementing SDIs at the local government level.

INSPIRE will have to focus more on local governments. The top-down and bottom-up approaches must be in balance. In view of the bottlenecks identified in this study, it is important to avoid thinking that 'the municipalities will catch up later'. Actions should be taken now!

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Examining SDI development of Turkey as a socio-technıcal approach

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1. Introduction

Turkey has speeded up her efforts to transform into an information society with eTurkey initiative which is almost identical to eEurope+. After 2003, these actions are combined in e-Transformation Turkey Project that aims at fostering the evolution and coordination of information society activities including National Geographic Information Systems (GIS) actions. GIS provides a powerful decision support in various application domains to planners and managers concerned with finding optimal solutions to complex problems (Longley et al., 2001, Yomralioglu, 2000). While GIS were largely designed to serve specific projects or user communities, Spatial Data Infrastructure (SDI) enables reducing duplication and facilitating integration of spatial data, not only technical but also social view. By this way, in this study, SDI development of Turkey was determined in respect of The Rainbow Metaphor compliant with the Information Infrastructure (II) approach by the Field Work examining the current situation on data / information sharing of Public Institutions that use and produce spatial data.

2. II and rainbow metaphor to identify SDI

GIS is changing towards collaborative efforts for data sharing and use. Consequently, Information Systems (IS) have been re-conceptualized as II. It provides integrated solutions with the helping of Information and Communication Technologies (ICTs) and control varied technologies, policies, standards. SDI, beyond GIS and as a special case of II, enables the effective collection, management, access of GI. The II approach can provide interesting and useful insights to understand and explain technical and institutional complexities within SDI. Besides techno-centric perspective, socio-technical thinking around GIS/SDI is discernible in developing the concept. Therefore, socio-technical issues around SDI should be examined in developing countries like Turkey.
The rainbow metaphor for access II was proposed by Clement and Shade (1998). This metaphor was examined to analyze the dynamics of the Indian National SDI by Georgiadou et al. (2005). It emphasizes the interplay of social and technical dimensions in infrastructure development. Aydinoglu (2006) used this metaphor to examine current

situation on data / information sharing of Public Institutions that use and produce spatial data.

The rainbow metaphor recognizes the multiple usage patterns, in retrieving and creating relevant content, it encompasses conventional and new media, and emphasizes the interplay of social and technical dimensions in infrastructure development and defines which services are essential to whom. Mostly it helps identify 'access gaps', those social segments likely to be left out by market forces acting alone and hence emphasizes the need for protection via collective public initiatives. The seven layers of the rainbow metaphor include carriage, devices, software, content, service/access, literacy, governance as explained below on figure 1 also correspond to important regulatory distinctions between carriage and content (Georgiadou et al., 2005).

- ***Carriage***: Facilities to access and share information and telecommunication infrastructure, related policies to encourage e-government.
- ***Devices***: Affordable ICT devices that people operate to access information.
- ***Software***: Software that runs the devices and makes the connection to services. The use of free, open source, and customized software in SDI/II domains.
- ***Content***: The GI content people find useful.
- ***Service/Access***: Mechanisms that provide relevant information to citizens for their interaction, including data use and sharing.
- ***Literacy***: The skills that citizens need to take full advantage of everything mentioned before.
- ***Governance***: The way decisions are being made to develop and operate the infrastructure.

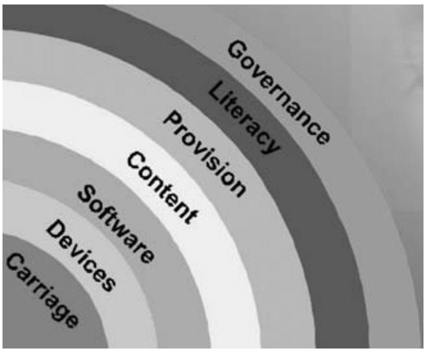

Figure 1. The rainbow metaphor for II (Clement and Shade, 1998).

3. Background: Turkey as a developing country

The Republic of Turkey was founded in 1923 by Mustafa Kemal Ataturk from the ruins of the Ottoman Empire after a far-reaching transition period. She is one of the largest countries, covering 780,580 km2 whole Anatolian Peninsula with a population of around 74 million (September, 2007 est.) (TURKSTAT, 2008) in the eastern shore of Mediterranean Sea as a bridge between Europe and Asia.

The republican parliamentary democracy in Turkey is made up of the unicameral Grand National Assembly of Turkey from 81 provinces with her democratic and secular political system. There are three base local administration systems which are province, county, and village. The province system, which constitutes the basic administrative parts of Turkey, is accepted as a base in view of central management, eliminating regional development differences, and providing a national wide balanced improvement. This administration forming integrity in its constitution is a small model of national administration of Turkey. She has memberships in a wide range of leading international and regional organizations like NATO and OECD.
Turkey's central priorities as a new vision can be summarized as focusing on meeting criteria for European Union (EU) accession, economic growth, reform of public administration and governance including decentralization, and reducing poverty and regional disparities. Also some national priorities, such as reduction in unemployment, developing the country's human resources, improved infrastructure services and environmental protection, and enhancing Turkey's role as a regional power and financial center (Prime Min. of TR, 2006). According to the 2007 Human Development Index (HDI) highlighting the challenges on human development, Turkey increased ranking to 84th out of 177 countries (UNDP, 2007) while 96th in 2004. Thereby, she is at medium level among HDI country performers. According to The Networked Readiness Index (NRI) by World Economic Forum that defines the degree of preparation of a nation or community to participate in and benefit from ICT developments, Turkey ranks 52nd out of 122 countries in 2007 (WEF, 2007).

4. GI usage in Turkey

Digital Maps started to be produced in Turkey after 1990s. Analog maps were converted to digital format and used as a base map in some specific projects. Public Institutions increased investments in ICT hardware and software since 1995s. General Command of Mapping (GCM) pioneered digital map production especially. Standard Topographic Maps (STM), with a scale smaller than 1:5,000, are produced by GCM. These maps are used as base map by public institutions, but the maps could not be qualified for various thematic applications of public institutions and accessing the maps is difficult because of secrecy in accordance with the laws. Large Scaled Maps, 1:5,000 and larger, are produced by Land Registry & Cadastre Directorate (LRCD) and State Provincial Bank. Other public institutions and municipalities also produce maps serving their own needs. As time goes by, the needs and requirements for geographic information have increased in Turkey like all over the world.

After 2002, Turkey has speeded up her efforts to transform into an information society with e-Transformation Turkey Project with eTurkey initiative identical to eEurope+. Successful e-government projects were initiated, such as e-Government Portal Turk Telecom, Central Census Management System Project (MERNIS), National Judicial Network Project (UYAP), Internet Tax Office Project (VEDOP), National Police Network

Project (POLNET), and like this. After 2002, Turkey has speeded up her efforts to transform into an information society with eTurkey initiative identical to eEurope+.
That triggered actions for building 'Turkey National GIS' under the responsibility of LRCD. Also, many GIS projects were produced by different public institutions. E-transformation Turkey Project, following Europe+, triggered actions for building "Turkey National GIS" with participation of public institutions. With Action-47, current situation to build SDI was examined in 2004. In Turkey, It has not been determined which institutions produce which data on which standard or scale (LRCD, 2004). With Action-36, Turkey National SDI strategy as policy encouragement was determined in 2005.
According to Turkey State Planning Organization (SPO) (2004), coordination has not been provided among public institutions that produce and use spatial data. Technical, Standard, and policy deficiencies result in time and effort losses on data production, management, and sharing. Public Institutions produce spatial data, depending on their responsibilities and rights legalized by the laws.
To examine the current situation on public Institutions that produce and use spatial data, the Field Work was prepared to examine not only technical and content but also a social view of SDI Development of Turkey. All public and private organizations concerning spatial data were determined. These were grouped hierarchically at *[0.] Government (Hükümet/Devlet), [1.] National (Ulusal), [2.] Regional (Bölgesel), [3.] Provincial (İl), and [4.] Local level*. The Provincial System is the main administrative unit of Turkey. Base principle is that if SDI is modeled for a province (İl), it can be a model from local to national level for 81 of provinces of Turkey. The field work was executed on 37 of public/private institutions and organizations (3.level) of Trabzon province that produce and use spatial data as seen on table 1.

5. SDI development process in Turkey

E-transformation Turkey projects triggered some actions to build National SDI. According to the Action-36 (LRCD, 2006) report, *Building National SDI is required to share spatial data on different context and scale efficiently, produced by all public institutions, organizations, companies, and universities that participate in Turkey National GIS*. LRCD have responsibility to manage the national SDI actions. It was noted that INSPIRE directive should be followed as a part of e-Europe participation. KYM-75, embarked on 2007, aims to build a portal where public institutions can present their geographic information (SPO, 2007). General vision and solutions were developed to build SDI nationally. Beside LRCD as responsible organization, spatial data producer organizations and some companies are participating in these actions.

SDI development of Turkey is described on seven-layered rainbow metaphor as explained below with carriage, devices, software, content, service/access, literacy, and governance components.

#	Public Institutions	Level	A1	A2	B1	B2	C	D	E
1	GOVERNORSHIP	3							■
2	PROVINCIAL PUBLIC MANAGEMENT	3	■		■				■
3	MUNICIPALITY	3/4	■		■				■
4	Provincial Dir. of Agriculture	3	■		■				
5	Provincial Dir. of National Education	3		■		■			
6	TEDAS-Provincial Dir. of Electricity Distr.	3	■			■			
7	TEIAS-Turkey Electricity Transmission Comp.	2	■		■				
8	DSİ-Regional Dir. of State Hydraulic Works	2	■		■				
9	Regional Dir. of Transportation	2		■	■				
10	TCDD-Turkey Regional Head Dir. of Railways	2				■			
11	DLH-Regional Dir. of State Ports & Airports	2	■		■				
12	BOTAS-Pipelines & Petroleum Transp. Comp.			■	■				
13	PTT-Provincial Dir. of Post	3				■			
14	Provincial Dir. of Telecom	3		■		■			
15	Provincial Dir. of Public Works & Settlement	3	■		■				
16	Regional Dir. of Highways	2	■		■				
17	Provincial Dir. of Land Registry and Cadastre	2							■
18	Dir. of Land Registry	4		■		■			
19	Dir. of Cadastre	3/4	■			■			
20	Regional Dir. of Provinces Bank	2	■						
21	Provincial Dir. of Health	3		■		■			
22	Regional Dir. of Turkey Statistics Institute	2		■		■			
23	Regional Dir. of Forestry	2	■						
24	Dir. of Forestry Management	3				■			
25	Provincial Dir. of Environment and Forestry	3	■		■				
26	Regional Dir. of Meteorology	2	■			■			
27	Council for Culture and Natural Ent. Preservation	2	■			■			
28	Provincial Dir. of Culture and Tourism	3	■			■			
29	MTA-Reg. Dir. of Mineral Res. & Exploration	2	■			■			
30	Provincial Dir. of Industry and Trade	3		■					
31	Provincial Dir. of Security	3		■		■			
32	Province Gendarme Command	3		■		■			
33	Group Command of Coast Security	2				■			
34	Provincial Dir. of Youth and Sport	3				■			
35	Provincial Mufti. of Religion	3				■			
36	Directorate of Navigation and Hydrography	1	■						
37	Undersecretariat of Marine	1	■		■				

Table 1. Public institutions that produce/use spatial data at provincial level (3. Level). A1: Spatial Data Provider; A2: Data Provider; B1: Direct User; B2: User; C: Developer; D: Legal; E: Decision Maker.

Governance

LRCD as a major producer of GI has responsibility to manage National GIS action, titled as KYM-75 in 2007. Spatial Data producers including General Command of Mapping as a national data producer, The Ministry of Interior, The Ministry of Public Works and Settlement, The Ministry of Agriculture and Village Works, The Ministry of Environment and Forestry, Turkey State Planning Organization, Turkey Statistics Institute, General Command of Mapping, Some Municipalities, and other related public institutions are participating National SDI actions. Also, public sector actors ESRI Turkey, NetCAD, and some other companies are involved in these actions.

There is no centrally management authority among institutions as a mediator to built NSDI in Turkey. The *Interministrial Committee* (BHIKPK) is responsible for the management of map related production processes for the entire country legally. But, BHIKPK do not have any accepted content and exchange standard and has not described as a part of National SDI activities of KYM-75. There is no coordination body as a National GI association working compliant with EUROGI.

On the scope of KYM-75, Technical, Legal, and Standard committees were built to trigger Turkey National GIS since 2007. INSPIRE principles were being accepted. And, these commissions are responsible to follow INSPIRE directive.

Policy approach to manage SDI activities

With Action-36, Turkey National GIS concept and implementation models were determined in 2005. But, a legal framework has not been initiated for SDI development yet. Legal and technical regulations for distributing, distributing, pricing, and managing spatial data have not been put into practice yet. Access to Public Sector Information accepted in 2003, Public Institutions are responsible for presenting all kinds of information and documents. According to 5216 numbered Municipality Law and 5272 numbered Metropolitan Municipality Law, municipalities are compulsory to build GIS and Urban GIS.

Numbering and National Address Database Regulation supports numbering streets and buildings, forming address information, registering on the database, and relating with birth record. The Ministry of Interior, according to Geographic based Province-Urban Management and Information System Technical Report (2007), supports standards for GIS projects of governorships and municipalities of each province are in developing process. This solves technical and administrative problems. The Interoperability Circular published by prime ministry of Turkey constitutes standards to build information systems in all central and local public institutions. Turkish Standards Institute (TSE) Geographic Information Mirror Committee emphasizes using ISOTC211 standard.

Literacy

Central Public Institutions have more eligible and well-educated personnel according to a survey from GIS Personnel working in Public Institutions. Most of them are experienced on GIS. 61% of personnel are educated on GIS. Half of them are surveyors. Data/information sharing is not at the expected level because of security considerations and poorly understood technical issues.

According to Field Work pointed out public institutions at provincial level

Municipalities, Cadastre, Environment/Forestry, Highway, and Water Directorates have personnel to manage spatial data and GIS applications. But, Agriculture, Health, Education, and Electricity Directorates do not have employers to manage GIS applications. Provincial Public Management (İl Özel İdaresi) have most of GIS applications at local level. But, do not have qualified GIS employers. All institutions have ICT sections, but most of them generally do not have employees to manage servers and network based on SDI implementations. The importance of National GIS/SDI has not perceived by employers yet.

Service/Access

In the survey it was asked which dissemination method is used for data sharing in Public Institutions. Data are provided either on CD (28%) or on paper (21%). Internet (17%) are sometimes used. In Intra-Institutions, CD (26%) and paper (21%) are also common to exchange spatial data. Access database from local network (23%) provide an effective method to exchange spatial data. HBB-*Harita Bilgi Bankası* (Map Information Bank) project was funded to build clearinghouse nationally. This project was managed by LRCD. This enables reaching information about large scaled spatial data that various institutions produce and maintain. The mechanism was designed but not browsed yet. National metadata standard was designed based on ISO standard. There is not any online services to download core spatial datasets that contribute the national SDI initiative. There are web mapping services available for core spatial data including:

- Geographic Names Database by GCM;
- Digital Turkey Databases by GCM;
- Soil and National Agriculture Information System, and especially,
- Metropolitan municipalities have web based mapping applications.

GCM website provides description about their maps and digital products, but online dissemination is not possible. Some e-government and internet GIS services for citizens were produced for agriculture, transportation, and other thematic sectors to present the maps. Almost all provinces and municipalities browsed the information on internet. Most municipalities in especially big provinces are trying to build Urban Information System (UIS) and e-municipality applications. According to UIS Survey executed by TUIK (2005), to 3066 out of 3228 municipalities of Turkey, 18% (543) of the municipalities have numbering unit and 4% (126) of which work on Urban GIS.

Content

The geodetic reference system and projection systems are standardized, TUTGA (Turkey National Base GPS Network) based on ITRF-96 (International Terrestial Reference System) with GRS-80 (Geodetic Reference System-1980). There is no a documented data quality control procedures. UVDF-National Data Change Format determines data types and data flows, based on XML format. But, it was discussed that UVDF can be updated for national GIS development and compliant with GML 3.1 and OGC Specifications. The national language Turkish is the operational language of Turkey's GIS projects. Spatial Data Standards have not been concluded yet. According to Action-36, It is accepted to follow INSPIRE Directive. Reference and thematic themes were determined, depending on INSPIRE Annex themes. It was pointed out that, first, spatial data should be produced on common data specifications from national to local level. Metadata rarely can be accessed online. There is no metadata standard among public institutions. Action 36 determined Metadata Standard, but not legally accepted. GCM has their own metadata standard. The action determined metadata standard based on HGK. And, on the scope of HBB- Map Information Bank project, metadata standard has been determining based on ISOTC211. ISOTC211 standards are being translated into Turkish language by TSE GI mirror committee.

Public institutions produce spatial data, depending on their needs. Institutional responsibilities have not been determined and spatial data was produced repeatedly. It can be seen what kinds of spatial data can be produced by which public institutions on table 2.

Contents	Producer	Spatial	Non-Spatial
Address	Local Administrations The Post Office	Road, Street, and Building from The Present Time Map	Numbering, District, Road, Street Post Code
Reconstruction Plans	Local Administrations	Border of land use, Symbology	Plan Notes, Definition of usage type
Cadastre and Ownership	Gen. Dir. of Land Registry and Cadastre Directorate	Cadastre Maps	Land Registry and Cadastre data
Infrastructure	Local Administration Gen. Dir. of Provincial Bank DSI-Gen. Dir. of State Hydraulic Works Turk Telecom Gen. Dir. of Highways TEIAS-Turkey Electricity Works Company DDY- State Railroads BOTAS- Petroleum Pipeline Corp.	Electricity, Water, Natural Gas, Sewer System Canal, Irrigation Telecom lines, Cable TV Highways, Crossings, Road building Works High Tension Lines Railroads Pipelines	Related attribute data like elevation, type ... etc. Related attribute data
Geophysics / Geology	MTA-Gen. Dir. of Mineral Research & Exploration Local Government	Geology Maps Microzon Maps	Earth layer data Microzon data
The Present Time Map	Local Government Provincial Banks	All details in Regulation of Large Scaled Map Production	Related attribute data
Standard Topographic Map	Gen. Dir. of Land Registry and Cadastre Directorate HGK-General Command of Mapping	All details in Regulation of Large Scaled Map Production	Related attribute data
OrtoPhoto Images	In most organizations	Raster Images	Attribute requirements
Meteorologic	Gen. Dir. of Meteorology DSI-Gen. Dir. of State Hydraulic Works EIEI	Temporal symbol, line, and areal presentations, depending on meteorologic data	Heat, Humidity, Wind, ... etc.

Table 2. Existing data and contents.

Examining GCM STM Data Dictionary, each feature was identified by NATO DIGEST feature code and grouped in feature classes. Feature classes are not defined with attributes and relationships for using in GIS applications. When Land Registry and Cadastre Organization (LRCD) determines boundary of land ownership at 1:1000 scaled maps, TAKBİS manages cadastral data and is being developed to adapting Urban GIS and other systems. Large Scaled Maps are produced, depending on Large Scaled Map Production Regulation (BÖHHBU). BÖHHBU was revised and enclosed with feature/attribute catalog in 2006. But, this catalog was not designed to solve application-driven requirements and SDI expectations for various GIS projects. GIS applications of local governments were developed, depending on GIS software and related companies. Therefore, spatial data is not interoperable. Interior Ministry is in the process to combine the databases of National Address Database (UAVT) and National Citizenship System (MERNIS). And, also Building Following System is being built to work with these systems. Local Governments can combine these data on their own Urban GIS applications.

Software

According to the survey executed in public institutions relating to GI at government level

Microsoft architecture (65%) is very common in Turkey as operation system. Public institutions are not familiar with open source programs. Besides Microsoft based DBMS SQL Server (27%), Oracle(32%) is the most common DBMS in public institutions. It was declared that 81% of public institutions using GI have GIS software. Institutions

use different kinds of GIS software. National software NetCAD is popular because it produces acceptable interfaces in Turkish legally.
There are no accepted international or de-facto standards in public institutions. Public Institutions generally use institutional standards (41%) in intra-organizations and accepted national standards (19%) but base level.

According to Field Work pointed out public institutions at provincial level
In 70% of which, NetCAD is common. managing the data in GIS environment have difficulty. In 30% of which, international GIS programs like ArcGIS are very common. Most institutions do not have database and image processing software.

Devices
According to the Field Work pointed out public institutions at provincial level
All public institutions have PC and hardware capacity to use and analyze spatial data. Almost all public institutions have Windows based platform. In 45% of which, Web Servers enables publishing the data on internet. Out of these, almost all institutions can publish their web page on web servers situated in General Directorates or any service provider. In 30% of which, Data Servers enables managing the data intra-organizations. Especially, General Directorates of these institutions manage spatial data centrally. For example; TAKBİS, Land Registry and Cadastre Information System, enables managing cadastral data centrally. All cadastral directorates can reach and edit these data by access permission. Especially Metropolitan Municipalities have possibilities to manage and share spatial data on Web/Data Servers.

Carriage
Turk Telecom, was a monopoly for long years, are in privatization process. Telecommunication Law has been recognized to renovate old laws. Electronic Signature Law certified by Telecommunication Authority legalizes electronic signatures. Other laws; personal data, consumer, security law, and like this are in progress.

According to Field Work pointed out public institutions at provincial level
Internet access has been provided with dial-up connection until 2003. ADSL users started to increase enormously since 2004 but not at expected level. In 40% of which, intranet and internet access is at very well level to use and share spatial data. In 50% of which, intranet access is at very low level to manage the data on networked environment. But, internet access with ADSL enables to reach the data. In 10% of which, data sharing on networked environment is impossible.

6. Conclusion

This study can provide a general perspective to examine National SDI development of Turkey with socio-technical view. Various ICT policies and e-government projects concerning National SDI were initiated, but coordination is not at expected level in Turkey. National GIS actions, similar to National SDI vision, were initiated under responsibility of LRCD. To build Turkey SDI, general vision is determined, but standards, policies, and process based actions have not determined yet. Although INSPIRE Directives and Annex data themes were accepted, there is no active coordination with INSPIRE initiative. As explained above, GI users in public institutions and private companies can't use the data in a corporate way to support decision making process because software and data standards have not determined yet. Building SDI for Turkey needs the leadership to manage GI related governmental activities and to put e-government, II, and SDI initiatives into practice.

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SDI as a distant ship on the horizon of EGov

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1. Introduction

The incorporation of geo-ICT in the public sector has been described and researched by diverse projects and programmes. Two prominent developments which were relevant for this incorporation were:

1. The stimulation of geospatial data/information infrastructures (often abbreviated as either SDI or GDI – hereafter referred to as SDI). This would initiatives in global, national, regional and local administrations, as well as cross-organizational initiatives such as authentic registers and streamlining of (geo-information) base data.
2. E-government or digital government (hereafter referred to as EGov), also at all levels of public administration, and cross-sector initiatives such as e-planning.

Each of these developments were initiated and further worked out by different communities of researchers and professionals, who have partly, but often not at all, overlapped. A recent question on the legal and economic forum the GSDI mailing lists on the relation of SDI and EGov triggered a serious wave of reactions, indicating that the issue of EGov is high on the attention register of many SDI academics and professionals. A similar question on an EGov mailing list would not have triggered so many reactions, even though SDI professionals are involved in many EGov programmes. Apparently, while the SDI boat hopes to be cruising in a similar direction as the EGov community, reversely, the wave of SDI is causing little to no disturbance to the EGov boat, and/or is simply undetected in the many waves that other ships are causing.

Undoubtedly, there is an increasing reference from prominent geo-information and SDI researchers that link geo-information to the issue of governance:

"Geo-information is a prerequisite for good governance, at all levels of aggregation (...). When talking about governance we should keep in mind that this implies decision making at different levels, i.e. local, regional, national, supra-national, and even global. This is because the dynamics of our living environment are generally the result of interacting geo-spatial processes at different levels of spatio-temporal aggregation." (Molenaar, 2006).

"The crux is that data infrastructures (...) offer considerable opportunities for restructuring government databases (...) in order to create an efficient, effective and legitimate government. With other words: for better governance." (Molen, 2005).

"There is a need to build a culture of the value of information sharing and collaboration and address governance models across all forms of government." (Rajabifard et al., 2005).

"It shows that SDI is in fact a part of E-government." (Bruggemann and Riecken, 2005).

Similarly, although not as frequent, from prominent researchers in the field of EGov there some reference to geo-information as:

"It became apparent relatively early in our analysis of the interviews that GIT (Geo-information technology) had played a special role in the response to the WTC attack and, due to its demonstrated effectiveness, attitudes about GIT were in the process of changing (...) it was clear that the integration of data through interoperable systems is central to the role of GITs in providing access to critical, yet disparate information necessary for effective delivery of government services." (Harrison et al., 2006).

(de Man, 2006) notes that the theoretical discussions of SDI are slowly but surely converging to similar discussions which were held within the scientific communities around public administration and governance. On the other hand, (Bekkers, 2002) in a Dutch publication also notes that while the discussions and aims of IT with public administration are similar, the rationalities of each of the communities are very different.
Furthermore, among the key findings and recommendations of the JRC workshop on Cost-benefit analysis techniques for SDIs held in January 2006 is the recommendation "To develop a *shared portfolio* of studies at different levels of granularity: the micro level (e.g. time saving, expenditure reduced or avoided within organizations), meso-level (cross organisational, regional, sectoral) and macro-level (national or international comparative studies) and build the knowledge base of assumptions made, assessment methods, and outcomes." (point 1, p. 5).

And, finally, the EGOV conference discussed the issue of EGov as a discipline. One of papers during these conferences was that of (Scholl, 2006), who stated that "Truly interdisciplinary studies have not yet emerged in EGov research (...) EGov research, this paper suggests, might be most effective when established as a multi-, inter-, and transdiscipline representing a more integrative understanding of knowing." (Scholl, 2006).

However, do the two communities need the same interdisciplinarity with a different name, or are we confusing different rationalities, and does each community understand the same things in the same way. This brings the need to verify whether SDI and EGov are similar in nature or fundamentally different. While there have been special tracks in some of the EGov conferences related to GIS in the public sector, or sometimes even to SDI, at the same time new issues have emerged within this community, which do not seem have any relation with the issues of SDI. The questions are:

- Can SDI research support EGov research?
- How can the knowledge and experience of SDIs contribute to the developments in EGov?
- Is there really a trend that the two concepts are converging?

In this article, I aim to find empirical evidence and references for these questions. I will do so by comparing the important words and 'jargon' of SDI community with those within the most relevant publications in the EGov scientific community over the past 6 years. It is a text-based analysis which should lead to a set of research directions for SDI in the context of EGov. I would like to show this phenomenon through an investigation of the publication outlets of both communities.

2. Methodology

Evaluation of congruence between SDI and EGov discourses is based on the theory of latent semantic analysis (LSA). LSA is a theory and analytical method for extracting and representing the contextual-usage meaning of words by statistical computations applied to a large corpus of text. It is based on word (co-)occurrences in documents, and has been studied for a variety of contexts, mostly from the computational point of view of how to generate automatic retrieval of information (Deerwester et al., 1990; Letsche and Berry, 1997), to cluster and index words and documents (Maletic and Valluri, 1999) , and perform statistical operations on words in documents (Bellegarda, 2000). The underlying idea is that the aggregate of all word contexts in which a given word does and does not appear provides a set of mutual constraints that largely determines the similarity of meaning of words and sets of words to each other. (Landauer et al., 1998). A software tool to carry out word analysis and frequencies in a (set of) documents is TEXTSTAT, described by (Huning, 2005), and freely available through http://www.niederlandistik.fu-berlin.de/textstat/software-en.html.

A particular interesting application is the use of LSA for the content-based positioning in learning networks. (Bruggen et al., 2006) describe learning networks as "an ensemble of actors, institutions and learning resources that are interconnected through and supported by information and communication technologies in such a way that the network self-organizes. In a learning network all actors are furthering the development of competence." In this definition research communities, such as SDI and EGov, can be considered such evolving networks whereby all actors are in need of 'furthering competence'. (Scholl, 2006) confirms this need by stating that "the fading appeal of the terms e-Government or digital government is not coincidental but may rather indicate a certain intellectual weakness in electronic-government research (EGR) concepts and a growing need for reassessing the EGR agenda".

This article will review large corpora of documents from the EGov community, based on the LSA and using the TEXTSTAT software[1]. It combines the review of articles, documents and major websites to look for the common grounds and missing links of SDI towards EGov. It aims to build new theory for SDI, to support the issues under discussion and research in EGov, and to view opportunities of SDI for the EGov discussions.

2.1 Choice of data and documents

The choice of documents to review was based on the (web) availability of documents, of major conferences and journals in EGov research. All documents are peer-reviewed documents, and reflect the most cited scientific literature in the EGov field. The type of conferences and literature reviewed are placed in the following table 1.

		2006	2005	2004	2003	2002
EGOV	Electronic government international conference	Krakau, Poland, 4/8-9-2006	Copenhagen, Denmark, 22/26-8-2005	Zaragoza, Spain, 30-8/3-9-2004	Prague, Czech Republic, 1/5-9-2003	Aix-en-Provence, France, 2/5-9-2002
HICCS	Annual Hawaii International Conference on System Sciences	Track 4 – EGov	Track 5 – EGov	Subtrack 5 – ETEDE, ETEGM, ETEGS, ETEPO	Subtrack 5 – ETEGM, ETEPO, ETEDE, ETEGS	Subtrack 5 – ETEGV, ETEPO
dg.o	International conference on Digital government research	ACM Proceeding Series; Vol. 151; 2006, San Diego, California, 21/24-2006	ACM Proceeding Series; Vol. 89; 2005, Atlanta, Georgia, 15/18-2005	2004, Seattle, WA, 24/26-5-2004		
IJEGR[2]	Publication of information resources management association; published by Idea group Inc.	3 issues	4 issues			
JEG[3]	Haworthpress.com; University of Southern California	1 issue; 1 prepublication	4 issues	4 issues		

Table 1. Type of literature and conferences included in evaluation.

2.2 On the method

Separate corpora of text were first created for each separate conference or journal. With these corpora one can – using TEXSTAT – review (and export) frequencies of words, examine concordances (the related text where these words are being used), and one can combine the different corpora to a large corpus of text. These separate corpora allow to review differences and correlations between the conferences and journals, by

[1] There are various free software packages that create and compare corpora of texts based on word frequencies; a good comparison can be found on http://llt.msu.edu/vol9num3/review2/default.html.

[2] International journal of electronic government research.

[3] Journal of E-Government.

# of papers	2006+/2007[4]	2006	2005	2004	2003	2002
EGOV (abstracts of papers)			30	109	95	78
HICCS (pdf abstracts & papers)		38	28	24		
dg.o (pdf papers, & posters)		137	97	138		
IJEGR (abstracts of papers)		16	11			
JEG (papers)	9	4	19	24		

Table 2. Number of papers included in evaluation.

exporting the frequency lists to a spreadsheet and/or statistical software package. Here MS Excel and SPSS/R were used.
To overcome the difficulty that most complete papers are only available in pdf format which is not a possible format to process in TEXTSTAT, an analysis was made of the possible use of title and abstract text only – and not the whole file. This was done by first compiling a corpus of the abstracts of both HICCS'06, HICSS'05 & dg.o '05, which was than compared to a frequency list based on a corpus of all complete pdf-files (i.e. complete papers) from HICSS'06, HICSS'05 dg.o'05. The result shows the frequencies (figure 1) of some major words, and related correlation. The relative frequencies indicate the ratio of the frequency of a particular word as compared to the total number of words in the whole document.

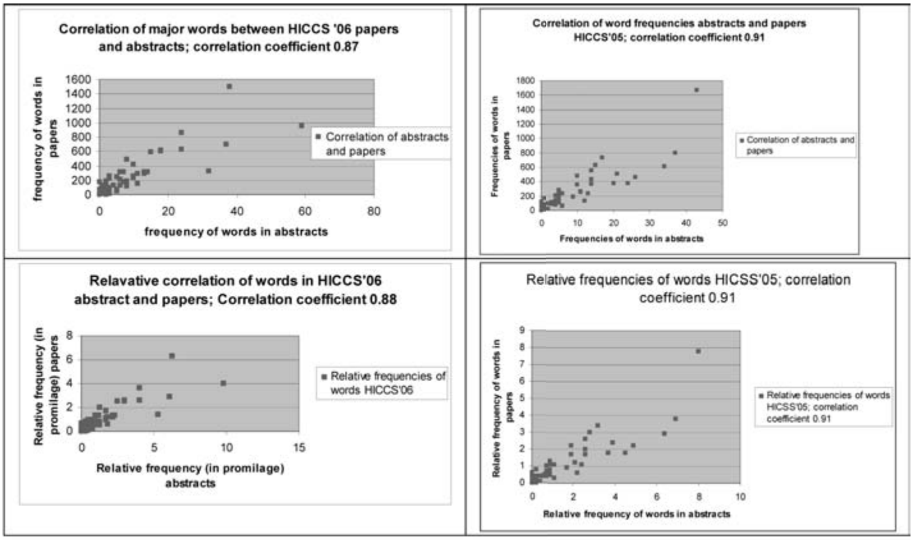

Figure 1. Frequencies of words.

[4] Either not yet published (or prepublication on the internet) , or published in another volume; EGOV publishes since 2005 additional papers in separate book by Trauner verlag.

We concluded from these results that there was sufficient correspondence between the abstracts and the full papers. From this we looked at abstracts as being reasonably comparable and efficient. It is still intended to look at a later stage at the full papers again. Based on this assumption we compiled all abstracts from the various conferences and journals. This resulted in tables of frequencies, relative frequencies and related concordances. From the concordances one can interpret further using qualitative analyses.

3. Results

Large corpora of documents from the EGov and SDI communities were used, in the LSA and with the TEXTSTAT software[5]. This relied on articles, documents and major websites. An initial overview of the issues in EGov shows a core set of issues, and a marginal set of issues. When evaluating the frequency of words in all combined abstract texts of the conferences one obtain the following top 20 words, as shown in figure 2.

Figure 2 shows two results, in promilages (‰), one showing the frequencies of all separate word appearances, while the other is the corrected number of frequencies. A corrected number corrects for example for the combinations or connections of words. For example a word as 'citizen' is often seen in connection with other words, e.g. 'citizen-centric'; 'government-to-citizen'; 'infocitizen'. In addition, the list of words was corrected for the number of strings such as 'use' in words like 'ho*uses*', or 'foc*used*', or

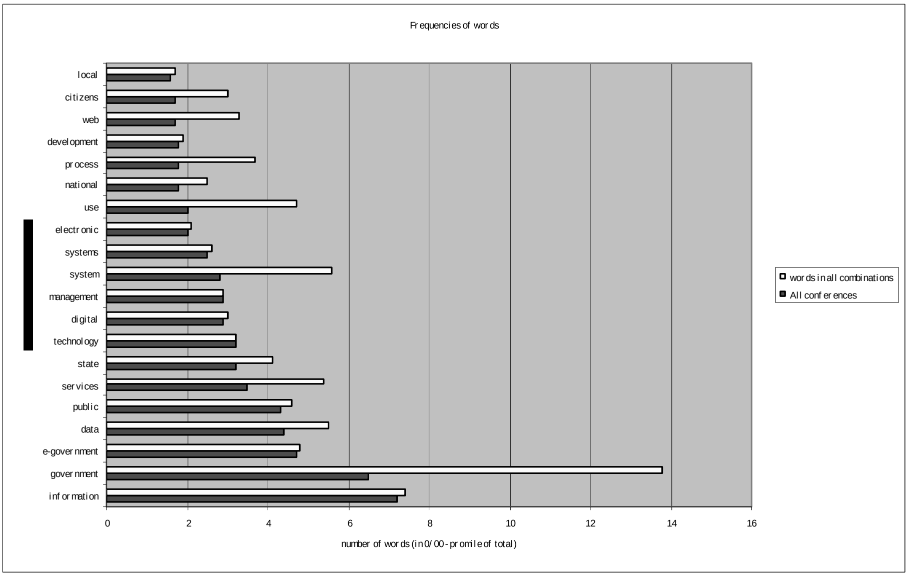

Figure 2. Frequencies of words (in ‰) in all combined conference abstracts.

[5] There are various free software packages that create and compare corpora of texts based on word frequencies; a good comparison can be found on http://llt.msu.edu/vol9num3/review2/default.html.

'because'. Table 3 indicates a number of combinations of words which appeared in the combination of texts, for which the total number of frequencies were corrected.

Single word	Combinations
Information	Geoinformation; information-based; information-intensive; information technology; information; Information; Informationl; Informational; Informationmanagement.
Government	Government; e-government; e-Government; Government; eGovernment; governments; E-Government; Governmental; E-government; Governments; Egovernment; government's; e-governmental; government-produced; Government's; academia-government; Governmental; iGovernment; Government-citizen; university-government-community; Government-to-Citizen; citizen-to-government; e-government-induced; university-government; e-governments; inter-governmental; nongovernmental; E-governments; government-to-public; government-citizen; digital-government; government-held; citizen-government; e-Governmental; intergovernmental; government-to-citizen; government-supported; multi-government.
Data	Data; databases; Data; metadata; database; datasets; Metadata; Database; meta-database; data-entry; cross-database; Databases; data-driven; Dataprocessing; dataset.
Service	Services; service; Services; Service; e-services; eServices; eService; youth-services; e-service; service-delivery; e-Services; service-based; E-services; Infra-e-Service; infra-services; service-oriented; E-Services; Service-Delivery; web-service.
Use/User	Use; used; users; user; uses; useful; User; usefulness; Use; Abuse; end-users; end-user; user-designer-programmer; Users; user-friendly; widely-used; User-centered; user-relevant; user-controlled; use-policies; Usefulness; misuse; user-designer; User's; user-partners; Usery; reuse; users-both; useless; Useful; Quality-in-Use; End-user; used2; user-survey.

Table 3. Combinations of words.

Even though corrections were performed, it must be noted that still the single words are used much more frequently than any of the combined words. For example the ratio of frequencies of 'information' as compared to 'geoinformation' is '615' as compared to '2', and similarly the frequency ratio of 'data' as compared to 'metadata' is '476/33'. As can also be seen from the figure 2, the frequencies of single words reasonably correspond to the combination of words. The only prominent exception is for the word 'government'. By far the most frequent and relevant word for the conferences is 'government'. This is not surprising, but at least it can be established that 'e-government' is firstly about 'government', and only secondly about 'information' or 'electronic/technology/ICT'. The number of combinations of strings of words which include 'government' – as can be seen from table 1 – is rather impressive. This confirms the above statement even more.

Figure 3 shows the relative frequencies of the words, and classifies the words into core topics (freq. > 1‰), related topics (0.5‰ <freq<1‰), and marginal topics (freq < 0.5‰). These promillages are not absolute as there are still a few corrections possible, yet it is valid to make a general classification. Combined with the SDI results it led to the following common and different foci.

Figures 4 and 5 show trends throughout the years, and frequencies of SDI related words in EGov fora. Increasing is the use of the words: state, information, Decreasing are

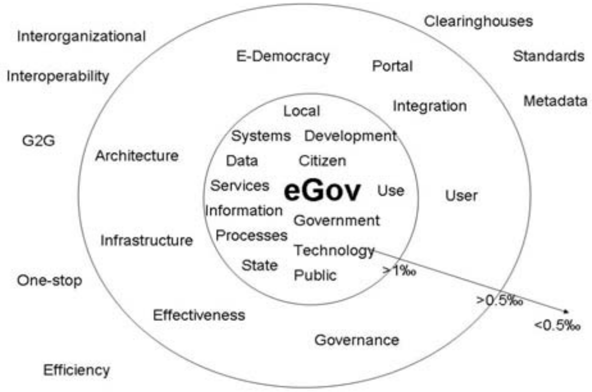

Figure 3. Issues in EGov, related to relative frequencies (in ‰).

terms service(s), citizens. There are also some smaller trends noticeable on less frequent appearing words – or less of 'container words', as can be seen from the Figure 5. Increasing is the reference to issues: interoperability, effectiveness, g2g. Decreasing are: one-stop, and efficiency.

In the EGOV conference series since 2005 a change took place in the publication of papers. A selection of mostly scientific papers and completed research projects were published in the Springer book, and a part of work in progress, workshop papers and PhD research in progress was published in a separate book of Traume, Linz. Publicly accessible at the internet are only the abstracts in the Springer book(s). This explain the low number of papers in 2005 and 2006. For 2006 an additional category to represent the papers in the Traumer book was made. It must be said that in the earlier HICCS conferences (2002, 2003) many of the technical issues of infrastructure were included in other tracks than the egov cluster, and that the number of papers under the heading of EGov were rather limited. Issues outside EGov included topics as mobile technology, infrastructure, interoperability and networks, etc, but these topics were not directly related to implementation within or for the public sector. In later HICCS conferences ('05) there were minitracks such as 'Egovernment infrastructure and interoperability', recognizing that this was a special feature within computer sciences, different from general infrastructure and interoperability. There are relatively few papers which specifically address EGov is gaining increasing insight in G2C, however, the necessary role of C2G is not yet properly understood.

4. Results relevant from SDI perspective

In recent years GIS / SDI has become less of an issue in EGov related literature and conferences, while governance has become a bigger topic in GI related conferences. The typical SDI related words do not appear so much in any of the EGov related documents. Little reference is made to key words of the (Moeller, 2002) framework: 'Metadata' (< 0.8‰), 'clearinghouses' (< 0.1‰).

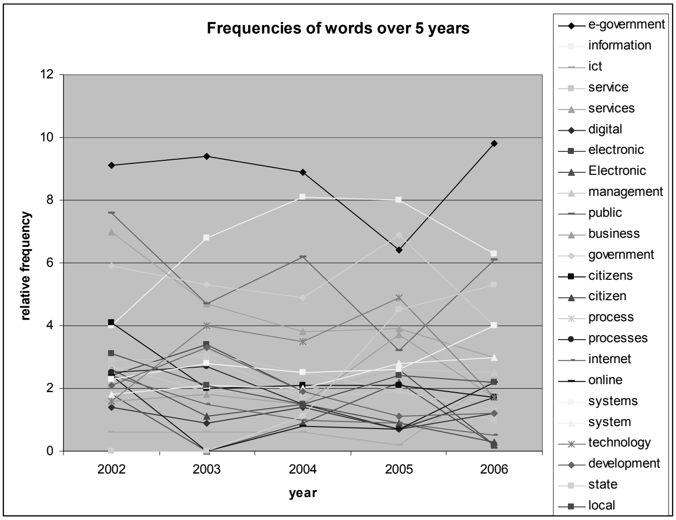

Figure 4. Trends and regression of words throughout the years.

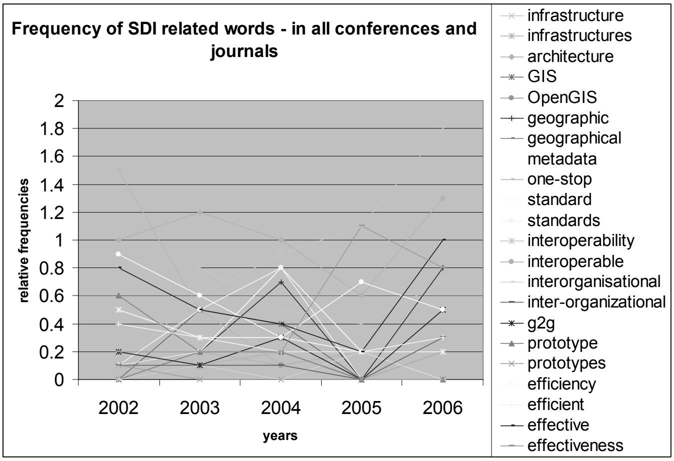

Figure 5. Frequency of SDI related words.

One could question whether SDI have nothing to offer (any more) to EGov, or whether the two field are significantly diverging? Or, does the EGov community spread so thin on many subjects and leave any voids which SDI community could fill in or support filling in. There are clear exceptions, though. The Dg.o'04 had quite a relative number of papers and abstract dealing with spatial data and geospatial data infrastructure. In addition, during the EGOV2004 there were a number of papers relating SDI to EGov and vice versa: papers from (Auksztol and Przechlewski, 2004) and (Nogueras-Iso et al., 2004) , for example. During dg.o'06 a number of papers discussed geospatial data in particular in the context of disaster management and emergency operations. There is some reference to information infrastructures but very little reference to the geo-side of this infrastructure.

In comparison to EGov literature SDI literature probably lacks the specific frequent reference to the words 'public sector' or 'for a public (sector) purpose'. Looking at the definitions one can also see a public purpose, and public goods, but not so much a public sector purpose. This may explain some of the differences with the community and the focus of the EGov/digital gov community, but may also be one of the missing links or choices in the SDI discussions. Research on SDI could be mainly research on how a public sector could make the utilization of GI a public matter (GI for eDemocracy, participatory GIS), or how GI could make public sector more effective and efficient (GEO – G2G) .

4.1 Analysis of results – the common grounds and the mission links

When looking at the degree of overlap of EGov with SDI, there is probably more than just touching surfaces, but the degree of overlap is not as big as originally anticipated. Yet, the major areas of interest could be depicted as in the following figure 6.

It must be noted that G2G was put in the realm of EGov because many of the publications are actually related to 'government' and 'information'. Most concordances relate these two concepts, so G2G – although not mentioned as such – seems an obvious extension of this relation of government and information. It is also an area in which the SDI community has gained considerable experience.

Common to both is an increasing focus on 'Local'. This follows the trend of decentralization in general, which has an effect on both EGov and SDI related issues. On the one hand, there are attempts to make a 'one-government' irrespective of the level of administration, on the other hand, from an informational and infrastructure point of view, this requires integration and harmonization of data acquired and/or distributed at different levels. The inter-relations and dependencies of local to national governments to each other is an important item here. Additionally, looking at the contexts in which 'Local' is used it is such that 'Local' may sometimes also be substituted with 'at any given place', referring much more to the internet and freedom of choice paradigms than the administrative level. In any case, 'Local' is a key word for both SDI and EGov.

What seems to be very different between the two fields of research is that within the SDI arena a lot of experience has been gained in G2G projects, as proves the number of empirical and practical examples in cooperation and information exchange between cadastres and municipalities, the streamlining base data which are largely spatially based or spatially referenced, the cooperation between water boards, provinces and public works (NL) for the purpose of a national height network. The application however, the

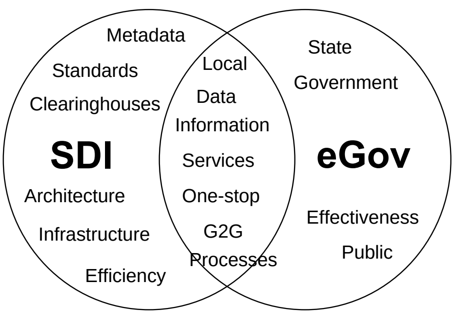

Figure 6. Major common and major specific topics in SDI and EGov literature.

impact of the new emerging hybrid structures, responsibilities, hierarchies, inter-organizational relations in this Geo-G2G are not yet completely described or understood, and would thus require further research. In fact, (Scholl, 2005) noted already that relatively little empirical research is done in the G2G field, while paradoxically most of the tax money is going to these organizational systems. In a number of G2G applications GI and the GI community plays a significant role. SDI nor EGov deal currently little with G2C and C2G, although the discussions are increasingly dealing with the rapidly developing C2C and B2C, C2B successes in the private sector (google earth, yahoo, navigation, location-based services (LBS)) This LBS may be relevant for mGov.

5. Conclusions

While the investigation shows considerable overlap, the results pose the question to which extent the scientific starting points of SDI and EGov are related, and whether the presumed communalities really exist. A possible explanation for the discrepancy and the different starting points between the two communities is sought in the different interpretation and relevance that is given to the issue of 'public services' and policies developed for these. Despite the overlap on developing information and services at local level for citizens, (where both are based on public sector systems integration and efficiency enhancement), the programmatic implementation is addressed from different communities (IT versus Geo), different legislations/authorities (home affairs & IT vs. housing, physical planning, environment) and from different interests (public sector reform vs. technical ownership, for example). This makes that you see very little overlap in the publications and very few links between actual implementation strategies.

Further research in SDI relevant for the field of EGov could therefore focus on finding empirical data and explanations on:

– Understanding and further developing how GI related services and information could support government processes.
– Test to which extent the figure of EGov is true in specific cases, for example in developing countries.
– How G2G relations which are specifically Geo-based are functioning and why; this includes issues the more socio-organizational relations and dependencies.
– How citizens make 'choices' in the field of GI. In the overload of choices, there are increasing calls of meta-systems for meta-information. The SDI field has traditionally gained a lot of experience with meta-data and developing the underlying philosophy for this. The relation of how choices are made and the bounded rationality of choices for government purposes has become important.
– Export the concordances from TEXTSTAT to a qualitative software package, like NVIVO or ATLAS/TI, to start a qualitative analysis.

Finally, on the methodology one could add:

– Of course on could question whether a summary of keywords would not result in the same analysis. The answer is no, because keywords, and other indications – such as library indications – do not necessarily cover a number of issues included and assumed to be known in the text. Keywords will rather focus on what is new, than on what is known.

– Another argument could be that not all EGov literature is included, especially not the one specifically related to infrastructures or GI. This is obviously true; yet, the literature chosen can be considered a good representation of the EGov literature at large.

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Crisis in the SDI field? Or a vibrant market of ideas and initiatives between rhetoric and praxis

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1. Introduction

The idea of Spatial Data Infrastructure (SDI) shows an impressive proliferation over the last ten to fifteen years worldwide. This trend is reflected by a markedly growth of professional and scholarly activities. [It is beyond the scope of this paper to even attempt to do justice to the vast literature that accompanies these developments. Reference to the volumes by Groot and McLaughlin (2000), Williamson et al. (2003), and Masser (2005), as well as the Global Spatial Data Infrastructure Association (www.gsdi.org) may suffice here.] Loosely formulated, SDI is the domain where spatial data, dedicated technology, and a multitude of actors (both producers and user of spatial data) meet. The SDI concept seems to be another 'promise' within the continuous development of spatial (or geographic) information technology. The so-called SDI Cookbook, for example, emphasizes the vital role of geographic information in decisions at the local, regional, and global levels and mentions crime management, business development, flood mitigation, environmental restoration, community land use assessment, and disaster recovery as just a few examples of areas in which decision-makers would benefit from geographic information and the associated infrastructure (i.e. SDI) that support information discovery, access, and use of this information in the decision-making process (Nebert 2004, p. 6). Nevertheless, its practical and operational implementation in concrete cases appears unruly and sometimes even problematic. For example, Crompvoets et al. (2004, pp. 665, 687) observe a declining trend in the use, management on content of national clearinghouses – one of the main elements of SDI facilitating access and providing complementary services. Implementing clearinghouses appears to be a complex task, fraught with difficulties in sustaining a shared language, a shared sense of purpose, and reliable financing (Crompvoets et al. 2008). Masser (2005, pp. 258-261) suspects some element of wishful thinking in many of the countries' claims of being involved in some form of SDI development. He also stresses the need to rigorously examine claims that SDIs will promote economic growth, better government, and improved environmental sustainability, and that more attention should be given to possible negative impacts. This is not a trivial issue because what we call success depends largely on the parameters of success (Mol 2002, p. 235).

From the outset it must be clear that there is nothing principally wrong in the use of ambitious rhetoric in the SDI field – or whatever field for that matter – in order to induce change like improving spatial data handling. Politics, for example, is as much about rhetoric, symbols, rituals, ceremonies, and myths (March et al. 1989, p. 7) as to the making and execution of authoritative decisions for a society (Easton 1957, p. 383). It is a different matter, however, when actors are uncritically carried away by their own rhetoric leading to a distorted perception of reality and even to "folly and wooden-headedness" as Barbara Tuchman might have put it (1985, pp. 2-6). Moreover, disciplinary rhetoric is common in the construction of knowledge throughout the sciences (Pinch 1990, p. 302). Social sciences theories can even influence reality by becoming self-fulfilling through language (Ferraro et al. 2005). The dilemma of rhetoric therefore is that it can be both a powerful condition for needed (social) change and at the same time a dangerous pathway to a collective fantasy world.

The apparent discrepancy between optimistic rhetoric and unruly reality of SDI implementation leads to the question whether or not the SDI field is in crisis. The remainder of the paper addresses this question. First the SDI field is sketched in terms of challenges to practical relevance and academic stature. SDIs are multi-faceted and different perspectives are possible. Moreover, the SDI field has formed its own community with the danger of intellectual isolation. The question whether or not SDIs are special and fundamentally different from other kinds of information infrastructure has only recently received wider attention in the SDI discourse. Questions regarding the disciplinary framing of research in the field of SDI have not been resolved yet. Next, the paper briefly explores how the SDI discourse can benefit from recurrent debates within adjacent fields of public administration and information systems about relevance to society and academic stature. These debates emphasize the role of praxis. Finally, the paper argues that the contemporary SDI discourse is far from being in crisis but rather engages a fruitful combination of rhetoric and praxis beyond the realm of technical, means-end relations.

2. Challenges to relevance and stature of the SDI field

The SDI field is challenged from at least two sides; practical relevance and its (sometimes) inward looking discourse. Practical relevance of concrete SDI initiatives is challenged by their ambiguity – they are multi-faceted. This implies that different perspectives are possible in understanding the concept of SDI and that concrete SDI initiatives can mean quite different things to different people. Moreover, different facets and perspectives may bring conflicts between different requirements, interests and values. Their multi-faceted nature makes SDIs complex beyond technicality or just being 'difficult'. Complexity is understood here as 'things relate but don't add up' and as 'more than one and less than many' (Mol et al. 2002, pp. 2, 11). Complexity acknowledges the possibility of emergence – unforeseeable properties and consequences (Windler 2003, p. 82). Complexity does not necessarily develop into higher-order unity and must be viewed as reciprocal reference of individual actors (Kwa 2002). Instead of capturing and controlling complexity, the challenge is to acknowledge multiple realities shaped by different and heterogeneous actors (Hilhorst 2004, p. 56). Under certain conditions, complexity will increase the reliability of systems under uncertainty – though within certain limits yet (Carlson et al. 2002, pp. 2539-2540).

The various facets that are generally embodied in SDIs – independent of time and place – include the following (De Man 2006; 2007a, pp. 40-42). SDIs are about communication and sharing of data and information both with as across different (governance) levels. They are networked infrastructures and would have 'network externalities' where all users benefit when a new user joins the network but could also have fragmenting, discriminating, and exclusionary effects. SDIs encompass both technical and social elements and are therefore socio-technical assemblies. SDIs are supposed to support a wide group of stakeholders in the communication and sharing of spatial data and can therefore be viewed in terms of a 'commons'. Consequently, they need a broader scope of analysis than narrowly defined economic issues. SDIs generally operate within unstable environments and the ability to adapt may be critical to their success and viability. SDIs may develop institutionalized properties in the abilities to communicate, connect, and share between stakeholders once implemented. Institutionalization of a concrete SDI initiative can be another condition for its viability and address the problems of obsolescence and irrelevance. Finally, the SDI concept may loose its distinctiveness over time and its spatial functionalities become integral part of information infrastructure in general (De Man 2007a; De Man 2007b). In summary, the SDI concept can be understood as socio-technical actor network emerging out of interplay between heterogeneous actors – technical and social elements. Because (most) actors pursue their interest, SDIs develop in a continuous process of negotiation and aligning the various expectations and other interests (De Man 2006, pp. 333, 338).

Apart from the ambiguity of its core concept, the SDI field is also challenged by its discourse. Spatial data handling technology has formed its own community and interactions with the broader sphere of information systems seem not always to have been strong. The convergence of computing towards open systems and interoperability, however, may now lessen the justification for a separate status of spatial data handling technologies (Reeve et al. 1999, pp. 177-185). Hence, there seems to be a real danger of intellectual isolation for the professional and academic communities in the fields of spatial information technology and of re-inventing the wheel (Goodchild 2006, p. 689) – including SDI.

Contours of the needed research for multi-level and service oriented SDI development can already be found in the literature. SDIs must be viewed as social phenomena (Masser 2006, p. 21). A multi-faceted view is needed in understanding their complexities (De Man 2006, pp. 331, 339). Some anticipate future research revolving around bottom-up SDI development, and specifically addressing multi-level stakeholder participation, cultural conditions, data sharing, and a multitude of contextual issues (Rajabifard et al. 2006, pp. 736-739). Future research increasingly will be characterized by 'multiplicity' – multiple stakeholders, multiple criteria, multiple objectives and multiple scales, together with differential levels of access, training and finance to differentials in spatial cognition, education and cultural background (Carver 2003, p. 68). Nevertheless, mainstream GIS journals continue a primarily technological theme, with some of them showing limited engagement in potential implications on the human, organisational and social world, and a predominantly positivist focus with expectations of technical benefits overwhelmingly dominating reflexivity and critique (Georgiadou et al. 2006). It seems that the contemporary GIScience finds it difficult to accommodate the apparently reflective and socio-technical research that is needed to effectively contribute to SDI development "and beyond". It would follow that the SDI community must engage itself in cross-pollination and cross-learning with other relevant communities (Bernard et al. 2005). Hence, it is insightful for the SDI discourse to draw upon the debates about relevance to society and academic stature within the adjacent fields of public administration and information systems. These fields represent as it were the use and technology domains of SDI respectively. [It is not possible within the limitations of the paper, however, to do any justice to the full richness of these discourses.]

3. Relevance and stature discourses in public administration and information systems

Public administration – or government for that matter – appears to be an unruly field for both practical and academic reflection. For example, the past 80 years or so have witnessed the raise and decline of big government and welfare state rhetoric. With the Great Depression of the 1930's, for almost 30 years, big government was regarded as the beneficent instrument of an expanding economy and increasingly just society. But after a generation has passed, government was increasingly seen as a potential threat to individual freedom and as the enemy of economic efficiency. The last decade even witnessed the appearance of the 'virtual state' (for instance Rosecrance 1996). Hajer and Wagenaar (2003, p. 3) observe a shift away from well-established notions of politics that challenge the familiar distinction between public and private. Politics, has to be connected to the everyday culture of its citizens in order not to become an alien sphere (Van Zoonen 2005, p. 3). Not surprisingly, the identity of public administration as a distinct field has been challenged. Raadschelders (1999, pp. 281, 298) argues that this "crisis of identity" in the study of public administration cannot be resolved by a unified body of theory because of its multidisciplinary and interdisciplinary nature and the continuous changing nature of government and government-society relations. Behn (1996, pp. 108, 119-121) views public management – which is admittedly more limited than public administration – as design. Public managers create organizations and arrangements that perform functions. Design engineering is a social process and a unique blend of science and art. Design also has a strategic component in that it may influence development trajectories into the future (Morello 2000). Snellen (2002, pp. 323-327, 334-344) argues that public administration must comply with different rationalities simultaneously. Because these rationalities are generally not mutually consistent and even try to suppress each other, conciliation of these rationalities can only be achieved in a case specific compromise.

Debates about relevance to society and academic stature also take place within the information systems field. On the one side, some see the information systems field as fully emerged as discipline in its own right (for instance Baskerville et al. 2002, p. 7). The other side is more skeptical about the field's central identity. Benbasat and Zmud (2003) even speak in terms of identity crisis within the information systems discipline. Here, some argue that the information systems field has not sufficiently engaged in the information technology (IT) artefact as its core subject matter (for instance Orlikowski et al. 2001, p. 121, who understand IT artefacts as those bundles of material and cultural properties packaged in some socially recognizable form such as hardware and/or software). DeSanctis (2003) takes a different view and proposes the lens of 'community of practice' to analyse the information systems field as 'situated learning' (see also Lave et al. 1991; Lesser et al. 2001). How members are attracted and retained in the social life of the information systems community will ultimate determine the legitimacy of the field (DeSanctis 2003, p. 374). Science revolves around important questions, not the domain per se (p. 368). Thus, Lyytinen and King (2004) argue that the legitimacy of the field lies in the plasticity of its praxis-focussed centre by adapting to the shifting salience of these questions and concerns (p. 232). Plasticity, however, poses a dilemma as well. It helps to produce strong results that are appreciated by society's dynamic demands and legitimacy would follow. But it also may threaten the field's identity, indirectly threatening its legitimacy (pp. 232-234). Lyytinen and King propose communication between the actors in this 'market of ideas' to discriminate between strong and weak results (p. 242). In a similar vein, Hirschheim and Klein (2003, p. 277) acknowledge communication deficits both internal and external. The current publication culture favours narrowly focused and highly specialized papers for in-group members of the different sub-communities. This leads to fragmentation of the field's knowledge base. They suggest the need for building both an action oriented, professional body of knowledge as well as new social networks to create and transform this knowledge.

These discourses emphasize the role of praxis. But there is another reason why the discourses in the fields of public administration and information systems are relevant for the SDI field. New vocabularies in both public administration and information systems fields are converging. For example, Hajer and Wagenaar (2003, pp. 1-30) refer to governance, institutional capacity, networks, complexity, trust, deliberation, and interdependence as a new vocabulary for describing developments in governing the public domain. Likewise, Ciborra (1998, pp. 12-15) speaks of care, hospitality, and cultivation in describing developments in information systems thinking. This convergence in vocabularies suggests direction for the SDI field to develop into networking and cultivation of socio-technical infrastructure.

4. The praxis-focused SDI field: science or market of ideas?

Against the backdrop of the relevance and stature discourses in the fields of public administration and information systems we will now turn to the question of under what reflective discourse the SDI field will thrive best. In other words, what kind of knowledge is needed to feed our deliberations? The answer to these questions greatly depends, of course, on (1) how the community sees SDI – as technical artefact or socio-technical actor network – and (2) how the community sees its relation to SDI – as only observing and understanding, or as intervening as well. These options imply community-based, constructed (disciplinary) rhetoric (Pinch 1990). The paper clearly proposes to view the SDI concept as socio-technical actor-network and – hence – the SDI field as praxis-focused. It then follows that knowledge comes by acquaintance with rather than knowing about (Benne et al. 1976, 128). This puts the focus on knowing in practice rather than on knowledge as such (Orlikowski 2000; 2002, p. 249). Knowing is in the action (Schön 1987, p. 25).

A praxis-focused SDI discourse must address nuances and fringes of information infrastructures. Ethnography focuses attention on this as well as on the practical materialities (concreteness) of infrastructures and helps in surfacing silenced voices, juggling disparate meanings, and in understanding the gap between words and deeds (Star 1999, p. 383; 2002, p. 107). Ethnography often challenges what we "take for granted" and provides researchers with the opportunity to get close to "where the action is" (Myers 1999, pp. 5-6). Narratives can grasp the complexity of SDIs. Narratives can be the stories told by the actors that were (and are) involved in the development of concrete SDI initiatives (see also Hedman et al. 2005). Most information infrastructures themselves, however, will have an inscribed narrative as well (Star 1999, pp. 384-387). It would then be a challenge to identify and surface master and other narratives and distinguish between them.

It is not clear how far the contemporary GIScience can accommodate such praxis-focused SDI discourse.

"Geographic Information Science (GIScience) is the basic research field that seeks to redefine geographic concepts and their use in the context of geographic information systems. GIScience also examines the impacts of GIS on individuals and society, and the influences of society on GIS. GIScience re-examines some of the most fundamental themes in traditional spatially oriented fields such as geography, cartography, and geodesy, while incorporating more recent developments in cognitive and information science. It also overlaps with and draws from more specialized research fields such as computer science, statistics, mathematics, and psychology, and contributes to progress in those fields. It supports research in political science and anthropology, and draws on those fields in studies of geographic information and society" (Mark 2000, p. 48).

The GIS artefact is clearly the core subject matter of this GIScience and its rhetoric reflects a technology imperative. GIScience delineates a domain but not necessarily important questions for society. A praxis-focused SDI discourse is concerned with the production of strong results for important and salient, societal questions rather than the formulation of GIScience as domain around a central (core) identity.

There is another reason why there is likely no single, well-defined core subject matter for a praxis-focused SDI field. The previous sections suggest that SDI is about a 'moving target' in that it is complex and multi-faceted – different things at the same time, dynamic and transformational, and constituted in a never-finished social process of negotiation. It would follow that learning, understanding, and intervening is multifaceted as well with unpredictable outcomes and emergent rather than following an a priori framework of inquiry. Such unruly process generally tend to be convulsive and revolve around dilemmas (Argyris et al. 1974, pp. 30-34, 99-120). Indeed, dilemmas indicate and reflect value conflicts that are inherent in the design, implementation, and inquiry of SDI initiatives. The reflective practitioner (Schön 1987) has to come to terms with these dilemmas of inquiry for each specific case; specifically those revolving around the question of whether the inquiry at hand is about the generalized SDI concept or about individual SDI *initiatives*, about commonalities or about fringes and nuances – uniqueness. These include the dilemmas in SDI inquiry between breadth and depth, between generalization and particularization, and between objective (but thin) observations and rich insights as in ethnography.

It seems that the centre of the SDI field is like a market of ideas, approaches, and initiatives. In academic terms, the field may be understood as an aggregate of disciplines (or academic fields). Each SDI academic has to find a place within an academic field. A two dimensional frame may explain the choices to be made (Lyytinen et al. 2004, pp. 237-241). The first dimension is about how one sees the academic field: primarily as a vehicle for one's career advancement or as an incidental aggregate of people with shared interests. The second dimension involves the choice of whether or not to confirm to established theoretical constructs and modes of inquiry in the academic field. These two dimensions constitute a two-by-two matrix. The two 'poles' of the main diagonal represent the ideals (in Weberian terms) of being an established or a continuously emergent academic field – "dynamic of the provisional" (Schütz 1965). It can be argued that those who are relatively peripheral to any of the established, component academic fields are important for keeping the overarching SDI field viable. [This would be akin to Granovetter's 'strength of weak ties' (1973).] These 'peripheral' academic actors from different academic fields may develop into 'communities of practice' when sharing praxis. In their extremes, the two poles represent the dilemma in academic endeavours between rigorous solidification – if not: fossilization – and creative chaos.

5. The SDI field as vibrant market of ideas and initiatives between rhetoric and praxis

In this concluding section we return to the alleged discrepancy between optimistic rhetoric and often unruly and disappointing reality in SDI implementation. Here, the distinction between established, academic fields around accepted theoretical constructs and modes of inquiry and with technological artefacts as their central identity on the one hand and a fluid market place of emergent ideas and initiative on the other is informative. To the extent that the academic field is focused on a technical artefact as its central identity, rhetoric will easily go beyond its realm of expertise and competence. Rhetoric that SDI would promote economic growth, better government, and improved environmental sustainability is simply beyond technical expertise of the academics concerned how stimulating it may be from a psychological point of view. Trying to find (more) technical solutions to essentially non-technical problems will generally lead to unmet expectations and, hence, to frustration. On the other hand, an inter- or transdisciplinary SDI field as praxis-focused market place of ideas and initiatives may find it much easier to accommodate the tension between rhetoric and reality. Rhetoric can challenge and stimulate existing competences and expertise. Because its central identity is the praxis of SDI rather than the artefact, such market place may take the form of a 'community of practice'. As this has been mentioned before, how members are attracted and retained in the social life of this community will ultimately determine its legitimacy (DeSanctis 2003, p. 374). In this view the SDI field emerges as a vibrant market of ideas and initiatives within the fruitful tension between rhetoric and praxis as the loose network of workshops and discussion groups and the wide variety of research projects and initiatives show.

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Implications of privacy for INSPIRE and vice versa

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1. Introduction

Privacy and geo-information have a complex combination and relation. Generally, the higher the level of detail of geo-information, the more likely privacy of individuals is involved. The same applies to the sharing of personal information; the more personal information is being shared the more likely it is privacy interferences will occur. Both aspects are relevant for INSPIRE. The Infrastructure for Spatial Information in the European Community (INSPIRE) aims to stimulate geographic information sharing within the public sector. This paper assesses the extent to which privacy issues may interfere with the INSPIRE principles.
First, privacy as a concept is described. Then, location privacy is explained. Next, relevant privacy legislation in the European Union is provided. Then the INSPIRE principles are laid out. Finally, the paper assesses the extent to which privacy issues may interfere with the INSPIRE principles.

2. What is privacy?

Anyone may have some idea of what privacy means to him. Phrases that try to capture the concept such as 'My home is my castle', and 'The right to be let alone' (Warren and Brandeis 1890, p. 193; Cooley 1880) are often used to indicate what privacy is. Others have described privacy as a vague catch-all phrase that includes a variety of concerns, such as respect for the personhood, dignity, and autonomy of the individual, private property, and solitude (Marx 1998, p. 173).
However, the exact extent and meaning of privacy as a concept is difficult to capture in words because privacy is an elastic concept (Allen, 1988). In addition, privacy is a living, continuously changing thing dependent on socio-cultural factors (Koops and Leenes 2005, p. 132). Depending on one's perceptions different definitions of privacy may be developed. As a consequence, the relationships between privacy and cognate concepts (e.g., deception, secrecy, anonymity) are debatable because the boundaries of the concepts are unclear and depending on specific circumstances (Margulis 2003, p. 244). We regulate privacy so it is sufficient for serving momentary needs and role requirement (see Margulis 2003 referring to Westin 1967).
Margulis (2003, p. 415) found that many definitions of privacy share a common core of key elements. Key is control over transactions (interactions, communications) that

regulate access to self and that as a consequence, reduce vulnerability and increase decisional and behavioural options (Margulis 2003, p. 415). This, also, involves when personal information will be obtained and what uses will be made of it by others (Westin 2003, p. 431). At a conceptual level, privacy may be defined as: "individuals their freedom of self-determination, their right to be different and their autonomy to engage in relationships, their freedom of choice, their autonomy as regards – for example – their sexuality, health, personality building, social appearance and behaviour, and so on" (IPTS 2003, p. 139).

From a more practical standpoint, privacy is the "voluntary and temporary withdrawal of a person from the general society through physical or psychological means, either in a state of solitude or a small group intimacy or, when among larger groups, in a condition of anonymity or reserve" (Westin 1967, p. 7).

The attitude of individuals towards their privacy is context-depending. Similarly, contexts may change and impact attitudes towards privacy (see Westin 2003, p. 433; Margulis 2003). What must be kept private seems to differ from society to society (Whitman 2004, p. 1153; Bellman et al. 2004, p. 322).

3. Location privacy

Location information provides the position of someone or something at a certain point in time and with certain accuracy. It links place, time, and attributes. Some attributes are physical or environmental in nature, while others are social or economic (Longley, 2001, pp. 64-65). Location privacy may be defined as: "the ability to prevent other parties from learning one's current or past location" (Beresford et al. 2003). It may also be defined as the ability to control the extent to which personal location information is being used by others.

With data about a person's past and present locations, it is possible to impute aspects of the person's (future) behaviour. Moreover, linking the data of multiple people reveals human interactions, and behaviour patterns of groups (Clarke 2001, p. 208). In this way the location of a user provides important information to grasp the context of the user (Lee et al. 2005, p. 1006).

A name or an address alone may not impact on one's behaviour or private life. However, a combination of a name, an address or a mobile device, and other information can result in highly detailed and intimate personal data (see, for example, R. v. Plant). One may argue that revealing such data may impose a serious threat on the privacy of the individual that is linked to the device or address. For example, the device may be found frequently at the location of a mental hospital, which may suggest that the individual has a mental problem. Similar inferences can be drawn from visits to clinics, drugstores, coffee shops, tobacco shops, entertainment districts or festivals, political events, or ghetto areas with a criminal reputation (e.g., trailer home parks, scrap heap areas). Conclusions drawn from this information can interfere with the daily life of the individual (see also Gruteser et al. 2004, p. 13). This is especially annoying if the assumed visit to the coffee shop was in fact a visit to the supermarket just above the coffee shop. Or the visit to the tobacco shop was to buy a birthday card instead of

Cuban cigars. This may have undesired consequences such as spam, or a unfavourable situation for one's health insurance.

Research suggest that the privacy expectations of users of mobile devices may not be as high as one may expect (see Barkhuus 2004; Barkhuus et al. 2003; Chang et al. 2006, Kaasinen 2005). It may very well be that these users are unaware of the potential privacy intrusions, or do not have a way of verifying what is being done to their personal data (see Barkhuus 2004). Consequently location privacy may not be as highly valued as many suggest, and continuous surveillance of terminal devices not as intruding.

3.1 Type of data

Within a geographic context, privacy limitations will typically apply to the datasets with a high level of detail where, for example, individual houses or addresses can be used to reveal information about individuals. Small-scale datasets are often of such limited detail that it does not provide the ability to link the geographic information to individuals: privacy issues are not likely to limit the use of small-scale information. EU privacy legislation distinguishes three categories of information:

(1) sensitive personal information,
(2) personal information, and
(3) non personal information.

The first category includes data that is in itself considered to be sensitive such as health information. The second category, personal information, relates to information directly or indirectly identifying individuals. Examples of such information are the identifying information, such as a someone's name. Location information may indirectly identify someone, especially if the location information is at a high level of detail. Finally, non-personal data does not interfere with privacy. For example, location information at a 1:1,000,000 scale will generally be considered non-personal information.

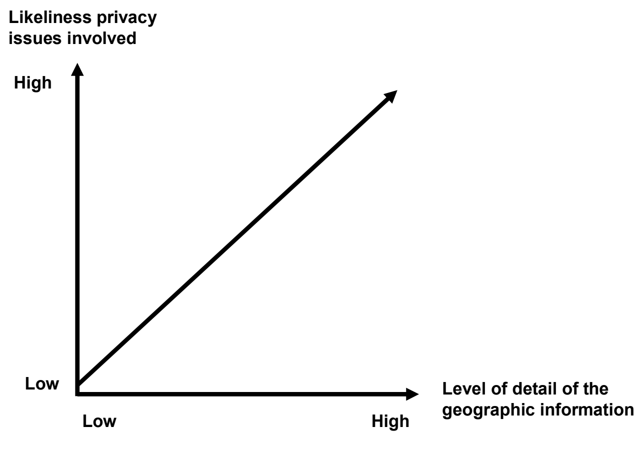

Figure 1. Relation privacy and level of detail of geographic information.

3.2 Timeliness

Time may have similar characteristics as location. The knowledge of what one is doing now may be considered private today. But 20 years from now, this information may be irrelevant. In this respect, Cvrcek et al. (2006) found that location data of mobile phones extracted in the first month seems to be most valuable: "An observer gets a lot of information at the start of an observation period, such as their usual moving pattern. Subsequent months add very little information, and can therefore be seen as less valuable both from the point of the observer, and the person observed" (Cvrcek et al. 2006). This holds until the observed individual shows unusual behavioural patterns. For example, if he is more than frequently visiting a nuclear power plant, or increasing the number of phone calls to certain people. These may indicate the preparations of an attack.

Barkhuus et al. (2003) consider information referring to a person's position a specific attribute of identity, similar to name and social security number. Generally, real-time location information is likely to be considered more sensitive than one's location in the past. In specific instances, however, this general guideline may not apply. For example, if this old location data is linked to a specific expectation (e.g., at work), and it appeared that this expectation was falsified (e.g., with a mistress), the location information might be personal information. The cyclist Michael Rasmussen had a similar experience in the summer of 2007. He reported to be in Mexico prior to the Tour de France, but a former colleague cyclist saw him in Italy at the time he was supposed to be in Mexico. When the former colleague accidently revealed this information, Rasmussen was fired and had to give up his number one position in the Tour de France. Thus, also linking rough location information to other information may result together in a set of information that can be considered personal information.

3.3 Context

The level of detail may not always be decisive for the judgment of an interference with the right to privacy. Also the (ease to) link to a specific context is important. If personal location information can be linked to a certain context (e.g., a church), this may impact the applicable privacy regime of the information. Linking location information to a 'sensitive' context will imply that the location information also should be treated as sensitive information.

The sensitivity of the location may also be related to one's profession, the characteristics of the location that could be identified, and other factors attributing to the profile. For example, information that a Dutch citizen is calling from the Netherlands is not very informative. Information that a Dutch citizen is calling from Colombia might be informative, especially if it appeared to be the voice of Tanja Nijmeijer (a supposed member FARC). However, if one's location does not have an impact on one's behaviour or performance in society, it can be considered non-personal data.

In addition, different users of the location information of another individual may have a potential different impact on that individuals privacy perception. Probably a different standard is applied to family and friends than to direct marketing companies.

Another component not specifically being addressed in research or legislation is information on what one is doing somewhere. Westin (2003, p. 445) suggests that the fact that it is known that one is at a certain location is less intrusive than the knowledge of what one is doing there (see Westin 2003, p. 445).

3.4 Summary

In a general sense, the use of highly detailed (e.g., scale 1:500), real-time location data linked to a sensitive context, such as a church, can generally be expected to be at a higher 'privacy level' than less detailed data (e.g., scale 1:25,000) of a decade ago without a link to a specific sensitive context. The context or circumstances determine whether location data may categorise as non-personal data, personal data, or sensitive personal data. The processing of location information may be among the most sensitive categories of personal information, e.g., if it is linked to a sensitive context or if it is tracked and traced real-time. 'Historical' location information may fall in the general personal information category. A special regime may apply to the processing of historical location data of cell-phones in the stand-by mode. Figure 2 provides a graphical overview of the relevant factors.

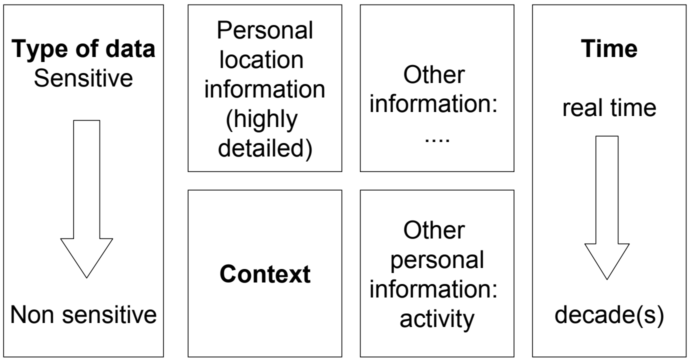

Figure 2. Relevant elements in decision whether location privacy issues are involved.

4. Privacy regulations in the European Union

The right to privacy in the EU Member States have their basis in the (European) Convention for the Protection of Human Rights and Fundamental Freedoms (article 8 ECHR). Article 8 ECHR reads:

1. Everyone has the right to respect for his private and family life, his home and his correspondence.
2. There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others.

Also the Council of Europe's Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (Convention no. 108) requires contracting parties to implement the principles set forth by this Convention. The purpose of the Council of Europe's Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (Convention no. 108) is "to secure in the territory of each Party for every individual, whatever his nationality or residence, respect for his rights and fundamental freedoms, and in particular his right to privacy, with regard to automatic processing of personal data relating to him ("data protection")" (article 1 Convention 108). The focus is on the processing of personal data. Article 5 of Convention no. 108 provides the general principles for data processing (the "common core"):

"Personal data undergoing automatic processing shall be:
a. obtained and processed fairly and lawfully;
b. stored for specified and legitimate purposes and not used in a way incompatible with those purposes;
c. adequate, relevant and not excessive in relation to the purposes for which they are stored;
d. accurate and, where necessary, kept up to date;
e. preserved in a form which permits identification of the data subjects for no longer than is required for the purpose for which those data are stored"
(article 5 Convention 108).

Further, article 7 rules that appropriate security measures shall be taken for the protection of personal data stored in automated data files against accidental or unauthorised destruction or accidental loss as well as against unauthorised access, alteration or dissemination. Article 8 provides that data subject rights to establish the existence of an automated personal data file, the right to rectify personal data, and to have a remedy if his request is not complied with.
Although Treaty 108 may be considered not very influential because "..... the Strasbourg Court and Commission have paid very little attention to 'their own' Council of Europe's Treaty 108" (IPTS 2003, 123), its' principles are also found in the EU Directives governing data protection (Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, and Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications).
Two EU Directives governing on data protection are, among others:

– Directive 95/46/EC of the European parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data (data protection Directive).
– Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications).

Directive 95/46/EC is the general data protection directive. Directive 2002/58/EC particularises and complements Directive 95/46/EC. These directives provide the legal framework for use of personal data. Member States may restrict the scope of Directive 95/46/EC and Directive 2002/58/EC for the processing of personal data concerning public security, defence, State security (including the economic well-being of the State when the processing operation relates to State security matters) and the activities of the State in areas of criminal law (see art. 3.2 and art. 13 Directive 95/46/EC and art. 1.3 and art. 15 Directive 2002/58/EC). For example, national government may decide that personal data processed for commercial purposes must be accessible to law enforcement and intelligence agencies to address severe criminal acts or to protect national security.

Directive 95/46/EC rules that personal data may be processed only if (article 7):
- the data subject has consented to the processing;
- necessary for the performance of a contract to which the data subject is party (..); or
- necessary for compliance with a legal obligation to which the controller is subject; or for the performance of a task carried out in the public interest (..);
- processing is necessary in order to protect the vital interests of the data subject; or
- necessary for the purposes of the legitimate interests pursued by the controller or by the third party or parties to whom the data are disclosed, except where such interests are overridden by the interests for fundamental rights and freedoms of the data subject.

The Directive only addresses the processing of personal data. In the Netherlands, the level of detail in geographic information that should be considered personal data has been set below the 6 digit zip-code level (6PPC). Other counties may have different

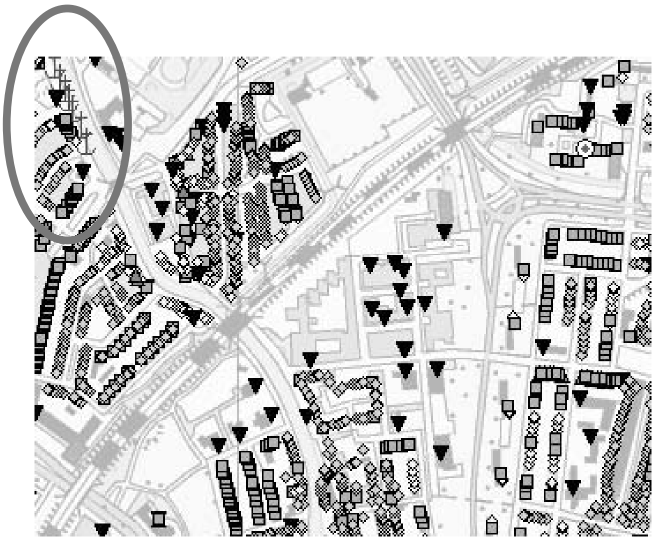

Figure 3. Profiling based on geographic characteristics involved interference with the right to privacy (highlighted area refers to house boats).

interpretations of the personal information definition of the European privacy Directive 95/46/EC provisions (see Korff 2002).

5. INSPIRE

INSPIRE is the EU Directive 2007/2/EC directed at the development of an Infrastructure for Spatial Information in the European Community. It should assist policy-making in relation to policies and activities that may have a direct or indirect impact on the environment. 34 general data themes have been identified as INSPIRE theme including cadastral parcels, addresses, transport networks, orthoimagery, and land use. The exact specification of the data themes (e.g., level of detail and content) will be developed by expert teams and approved through Implementing Rules. This process is not finalized yet.

The following principles are underlying INSPIRE (see INSPIRE 2002):

1. Data should be collected once and maintained at the level where this can be done most effectively.
2. It must be possible to combine seamlessly spatial information from different sources across Europe and share it between many users and applications.
3. It must be possible for information collected at one level to be shared between all the different levels, e.g. detailed for detailed investigations, general for strategic purposes.
4. Geographic information needed for good governance at all levels should be abundant and widely available under conditions that do not restrain its extensive use.
5. It must be easy to discover which geographic information is available, fits the needs for a particular use and under what conditions it can be acquired and used.
6. Geographic data must become easy to understand and interpret because it can be visualised within the appropriate context and selected in a user-friendly way.

It requires to make new digital data accessible through discovery, viewing and downloading services, among other (see article 11 INSPIRE). Recital 24 of the Directive refers for network services to Directive 95/46/EC:

"The provision of network services should be carried out in full compliance with the principles relating to the protection of personal data in accordance with Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data."

Public access may be limited if this would adversely affect the confidentiality of personal data where the person concerned has not consented to the disclosure of the information to the public where such confidentiality is provided for by national or community law (art. 13.2 (f)). Article 17 provides the framework within which geographic information may be shared in the public sector. Article 17(1) reads:

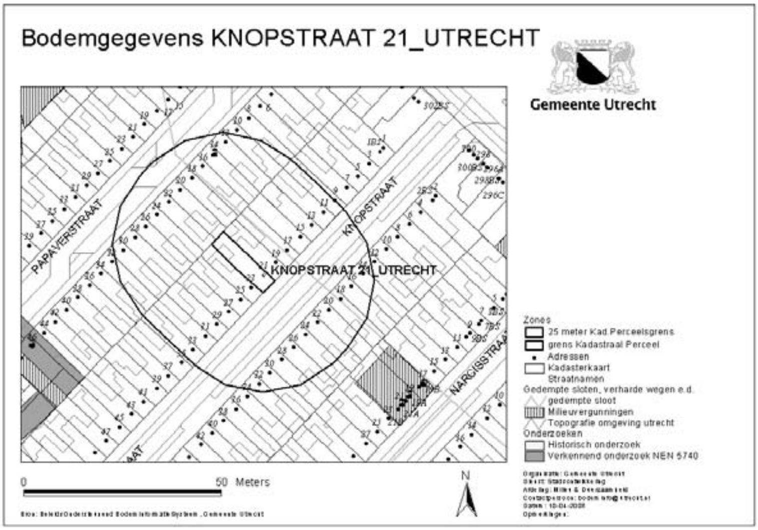

Figure 4. Soil data in the province of Utrecht (Netherlands) combined with cadastral parcel information: privacy involved?

"Each Member State shall adopt measures for the sharing of spatial data sets and services between its public authorities (....). Those measures shall enable those public authorities to gain access to spatial data sets and services, and to exchange and use those sets and services, for the purposes of public tasks that may have an impact on the environment."

These measures shall preclude any restrictions likely to create practical obstacles, occurring at the point of use, to the sharing of spatial data sets and services (Art. 17(2)). Finally, in article 17(7) it is specifically stated that sharing may be limited when this would compromise the course of Public security, Court of Justice, National defence, or International relations. Privacy is not mentioned in this specific article.
It goes without saying that Directive 95/46/EC not only applies to the network services, but also to other ways of using or sharing geographic information, in the context of INSPIRE.

6. Privacy and INSPIRE

Location information comes in many shapes and sizes. The extent to which the use of location information interferes with the right to privacy depends on the type of information, the level of detail of the location information, the timeliness of the information, and the context to which it is linked. As a consequence, the extent to which location information can be considered personal data or sensitive personal data varies from situation to situation.
Although privacy is not as much addressed in INSPIRE, it may have an impact on the extent to which the principles of INSPIRE will be adhered to. The impact is for a major

extent depending on the outcomes of the decision making process on data specifications. If some data themes are required at detailed levels, privacy limitations may apply. These may also apply when a combination of different geographic information is revealing personal information. The combination of human health and safety information and cadastral parcel information may not always be allowed. The use may be blocked if combining these personal data does not adhered to one of the use justifications as specified in article 7(1) of the Directive 95/46/EC.
Since the exact data specifications of INSPIRE are not agreed upon yet, the extent to which the public task in Member States reaches with respect to combining geographic information unknown, and the interpretation of the Directive 95/46/EC varies per Member States, it is impossible to provide at this moment a general statement on the impact of privacy legislation on INSPIRE and vice versa. It may very well be that certain data sharing arrangements are welcomed by some EU Member States while in other Member States privacy law prohibits the foreseen sharing. Privacy law is a factor that should be taken seriously in the further development of the requirements of INSPIRE.

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