

Analysing organisational structures and SDI performance

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Abstract

Although SDI researchers widely agree that organisational aspects are of fundamental importance to setup a successful SDI, this awareness has not yet lead to much substantial research on the subject. This paper applies organisational theory concepts to interpret SDI development issues, and is divided into four parts. In the introduction, the importance of business processes for SDI is made clear. The second part surveys and evaluates the treatment of organisational aspects in SDI literature. In the third part organisational theories are introduced to demonstrate that the structural dimension of organisations and their business processes is fundamental to understand, analyse, and respond to the needs and problems of these organisations. This paper shows that this structural dimension, both at the organisational and the inter-organisational level, is almost completely missing in SDI literature. However, the structural dimension in particular is relevant for SDI performance, as is presented in part four. This paper ends with the formulation of the hypothesis that SDI performance will be influenced by (inter-)organisational structures. This hypothesis will be tested in a series of case studies in 2009.

Keywords: SDI performance, business process, division of labour, organisational structures

1. INTRODUCTION

Spatial Data Infrastructures (SDIs) are complex phenomena combining many more elements and aspects than a mere technological perspective can unravel. Yet the vast majority of studies on SDI focuses on technical aspects (Koerten, 2008). An SDI is typically defined as a set of interacting organisational, technological, human and economic resources that are available for facilitating and coordinating geographic information access, use and sharing (Nedovic-Budic et al., 2008; Rajabifard et al., 2002). In other words, an SDI is defined as means (combined resources of various kinds) to achieve a specific class of ends (defined in terms of geographic information accessibility and dispersal). However, in both the means and ends domains the predominant technological view of SDI is inherently limited because it addresses only part of the means of SDI and typically stops at data handling functions when the ends are concerned. The very notion of an infrastructure can only be meaningfully interpreted as the collected and aligned means to achieve specific ends, and not as these means in their own right or as just one class of these means. With respect to the ends it is important to establish that the actual goal of the SDI is not to serve the data handling functions per se, but to serve the 'needs of the user community', such as issues of globalisation, sustainable development, economic reform, political unrest and war, urbanisation, environmental awareness and human rights (Rajabifard et al., 2002). Because the typical SDI users are government and private organisations, the objectives of these organisations and their business processes are the pivotal elements for assessing the performance of SDI and to guide their design.

Connecting SDI to business processes of SDI users provides an attractive option for avoiding the typical technological bias in the SDI literature because it positions the SDI in a broader means-ends connection. A business process is the way in which organisations create products and services (Desmidt and Heene, 2005; Daft, 2001). From the viewpoint of a business process, "access" covers the acquisition of the data necessary for the process,

“use” the employment of the data in the process, and “sharing” the availability of the resulting data to others. Already in 1999, Chan and Williamson (1999) demonstrated that spatial data infrastructures do not and should not develop in isolation of the business processes they support. Although there has been little research done since on this specific subject, the importance of business processes for SDI is mentioned in literature, for instance, by Rajabifard et al. (2003a).

The objective of this paper is to explore how SDI links to the characteristics of these business processes. More specifically, the objective is to derive how connecting SDI to business processes results in research hypotheses.

2. ORGANISATIONAL ASPECTS OF SPATIAL DATA INFRASTRUCTURES

This part of the paper discusses the treatment of organisational aspects in SDI literature. Even if the SDI literature is predominantly focused on technological, legal and economic aspects of SDI (Koerten, 2008), there is undeniably an increasing stream of studies that address the organisational sides to SDI. The time in which an SDI was merely considered to be a technical undertaking, is clearly over. In this literature overview of organisational aspects of SDI, also a short look at what GIS literature says on the organisational aspects of geographic data use and sharing is included, since GIS development can more evidently be situated in an organisational setting. The collected writings on organisational aspects of SDI address a plethora of disparate issues and concerns, making it hard if not impossible to detect unity in the smorgasbord they create. Among the topics addressed a key focus on social aspects of SDI is recognisable. For instance, Masser (2006) argues that SDIs must be viewed in the first place as social phenomena. In their report on advanced regional spatial data infrastructures in Europe, Craglia and Campagna (2009) declare that “[...] the main lesson of the European experiences, supported by those in the USA and Australia, is that Spatial Data Infrastructures are foremost social networks of people and organisations, in which technology and data play a supportive role. The technology is cheap, data is expensive, but social relations are invaluable.” A connected debate regarding the social side to SDIs is put in by Harvey (2006) who also talks about the critical importance of actor networks, in which individuals collaborate with each other, in contrast with social networks that institutionalise those collaborations.

Attention for the social side to SDI links to the role of individuals as members of networks and organisational collectives. Wehn de Montalvo (2003) introduces the theory of planned behaviour to identify the incentives and disincentives that determine the intention of key individuals within organisations to share spatial data. Key individuals function as indicators of likely organisational behaviour. Koerten (2008) also focuses primarily at the role of individuals when arguing that people’s perceptions, motives and expectations are more important to understand SDI practice than “just looking at what design of organisational structure is most effective”. Koerten also presents an interesting overview of literature that deals with organising in the realm of GIS and SDI. In the GIS literature a similar people-focus is recognisable. For instance, the handbook by Reeve and Petch (1999) is based on information system development methodologies, and its main message is to put the people first, and trade the “technology push” approach in for a “demand pull” one. GIS is seen as a device by which value chains can be made more efficient. Based on this shift from a techno-centric viewpoint to a, so called, socio-technical viewpoint, Rajabifard et al. (2003b) described the two SDI-generations.

A perhaps more negative connotation of SDI’s organisational side can be found in those studies that look for organisational impediments that hamper successful deployment of SDIs. Typical sources of such impediments are found in individual and organisational behaviour and organisational culture. As Koerten (2008) states, organisational aspects are considered important, but seem hard to conceptualise. Explaining setbacks and failures, practitioners

point at organisational impediments, but do not know how to deal with them. Probably as a reaction to the perceived top-down and techno-centric way of thinking in the early days of SDI development, almost every publication on organisational aspects of SDI stresses the importance of (organisational) culture and (individual and organisational) behaviour. According to Nedovic-Budic and Pinto (2001) the challenge of improving spatial data sharing rests firstly on a better understanding of individuals and organisations behaviour and their social and cultural aspects. Omran (Omran, 2007) uses a cross-cultural model for understanding individual and organisational spatial data sharing behaviour. Organisational behaviour is based on the culture theory stating that any organisational setting consists of two dimensions: grid (action) and group (identity) (Douglas, 1978). Omran and Van Etten (2007) also put a strong emphasis on willingness related to cultural aspects, although their use of social network analysis reveals some interesting aspects of organisational structure, showing that a hierarchical organisation structure could put serious constraints to spatial data sharing. Similarly in GIS literature, Campbell and Masser (1995) refer to Rogers (2003) diffusion of technological innovation, linked to social and political processes. Their conclusions are strongly organisation culture based. Organisational structures are discussed, but merely as a result of a certain organisation culture. For example, they found that gaining sufficient commitment for sharing and exchanging data, and for participating in the GIS, was extremely difficult in bureaucratic structures with little tradition of collaboration.

Several authors also address process models describing stages either in the innovation diffusion implied in SDI development or in organisational change recipes involved in managing an SDI initiative. Masser (2005) also describes the diffusion of innovation model, developed by Rogers (2003), identifying 5 major user categories: innovators, early adopters, early majority, late majority, laggards. Masser applies this model to describe the state of development of national SDIs in different countries around the world. The model is applied in a descriptive way, although the relation with a number of general country characteristics is examined. Rogers' innovation diffusion model is also used to conceptualise the intended role of the National Spatial Information Framework as "change agent" regarding the individuals in the different organisations. The results can provide a basis for specific guidance as to how policy makers may influence the actual behaviour of spatial data sharing more effectively. However, the actual business processes, within and between the organisations, within which the data sharing should be realised, fall out of the scope of this research. Wehn de Montalvo was the editor of chapter 8 of the SDI Cookbook (Nebert, 2004), resulting in guidelines indicating some outreach and capacity building activities, like awareness creation and information dissemination, that can be used to foster the implementation of an SDI. Vonk et al. (2007) combines a diffusion process model (that represents the formal and informal diffusion processes and pathways) with the technology acceptance model (describing a broad range of factors that explain organisational and individual information technology awareness and acceptance). Again, Rogers (2003) diffusion model is used. Based on mixed method research, Vonk concludes that knowledge about business processes and knowledge about technology should be brought together. Although the link with organisational structures is clear (even in the title of the paper), the concluding recommendations are again mostly actor-oriented, regarding management style, geo-information specialist skills, the appointment of an innovation manager, and management attention for bringing geo-information specialists and planners together. Nedovic-Budic et al. (2008) describe the concern-based adoption model (CBAM) to understand the uses (or non-use) of innovation. This model consists of three dimensions: stages of concern, levels of use and innovation configuration. Van Loenen and Van Rij (2008) propose a grow model aimed to explain how the SDI may evolve from several 'stand-alone' organisations into an institutionalised network of collaborating organisations. Four stages of development lead to SDI maturity. Each stage is in fact an ideal-typical description of organisational behaviour, but the possible explanations for this behaviour remain underexposed. Another view on the proliferation of SDI is described by de Man (2003), based on actor network theory, to explain the roles and importance of the main actors. De Man (2007) stresses that SDIs and other information

infrastructures are not fundamentally different, and uses Giddens (1984) structuration theory to formulate propositions regarding the institutional context of information structures, and the perspective of actor network theory (Latour, 2007) as ongoing processes of aligning and negotiating various interests. It is not made clear how these concepts can be applied in operational research.

A clearer move towards management advice is made by Rajabifard (2003) who also refers to Rogers (2003) to describe an organisational innovation process model, made up of two main stages, initiation (agenda-setting and matching) and implementation (redefining, clarifying and routinising). Three classes of factors are mentioned which are influencing the SDI-participation rate: environmental factors, capacity factors and SDI organisation factors. SDI participation is here about the engagement of member states in a regional SDI initiative. The possible utility of this approach to analyse the participation of organisations in actual spatial data sharing is dealt with. Craig (2005) elaborates on the importance of key individuals by describing them as white knights, driven by their idealism, enlightened self interest and involvement in a professional culture that honours serving society. Coleman et al. (2000) stress that geo-informatics professionals need specialised organizational and process management skills to facilitate the development and implementation of SDI, due to all non-technical issues related to data sharing within and between organisations, countries and regions.

Several studies address the inter-organisational domain. Nedovic-Budic and Pinto (2001) use the term “organisational interoperability” to assess inter-organisational interaction, coordination and implementation processes. McDougall et al. (2007) use a well designed mixed-method approach to evaluate spatial data sharing partnerships between state and local governments in Australia. The key objective of the qualitative component of the research was to examine the organisational frameworks of each of the partnerships. Although research was done explicitly from an organisational perspective, focus was put on the characteristics of the partnership, and the role and place of the individual organisation in the partnership. The actual business processes, within and between the organisations, in which the data sharing is realised, received only marginal attention. Harvey and Tulloch (2006) present research findings showing that local government data sharing aligns with immediate organisational and practical concerns rather than state or national policies and programmes. Based on a literature review Bekkers and Moody (2006) distinguish between instrumental factors (data sharing possibilities, technical knowledge needed, data quality) and institutional factors (attitude towards public participation and transparency, incompatibility of the datasets, privacy and intellectual property issues, power relations) that influence the usage of GIS for policy making. These factors are illustrated in a small case study, but a solid analytical framework is lacking. International assessments of national SDIs, like the Inspire State of Play (Vandenbroucke and Janssen, 2008) and SDI readiness studies (Fernández et al., 2006) contain a number of organisational elements, like the existence of a coordinating body, or the level of participation of data users and producers in the initiative. Such general indicators are useful to do a general assessment of a national SDI, but are not very helpful to describe and interpret (inter)organisational issues. Only a few studies take the viewpoint of an application field to assess SDI performance, like poverty management (Akinyemi, 2007) or local planning (Nedovic-Budic et al., 2004).

The connection between objectives and means to achieve these, is at the core of any infrastructure’s definition, including SDI. The conclusion that is drawn from the survey of the literature is that this fundamental connection is not systematically addressed. Business processes, and the organisational structures in which they are embedded, are the key vehicles when it comes to aspects of SDI performance and effectiveness. Although an SDI is aimed at supporting spatial data access, use and sharing in the network of business processes between and within organisations, little attention has been paid so far to the characteristics of these business processes. Even if several references to structures were

found in the assorted SDI writings, a systematic account of how different structures relate to different business processes and how SDI are to fit in these was not discovered.

3. ORGANISATIONAL STRUCTURES AND BUSINESS PROCESSES

In the world of today, products and services are created and distributed by numerous organisations, in which dozens, or sometimes even thousands of people are working. Therefore, the work has to be split up into work packages, in one way or the other. This is called “the division of labour”, which forms the central concept for describing the business processes, and the resulting organisational structures (Van Hootehem et al., 2008).

3.1 Division of labour: two basic forms

The fundamental decision regarding the division of labour is about the way tasks or operations are grouped into organisational units, and these units are grouped into larger units. Two basic forms can be distinguished: (1) division by function, and (2) division by product. Both basic forms can be found within and between numerous organisations. Of course there are quite some variations possible (Van Hootehem et al., 2008).

Division by function brings together in one organisational unit one type of operations, or several similar or related operations, that are called functions. For example, an organisation divided by function might have separate manufacturing, marketing, and sales departments. A sales manager in such an organisation would be responsible for the sale of all products manufactured by the firm (Stoner et al., 1995). The creation of the product or service is divided across various subsystems, which all produce only a limited part of the complete product or service. Homogeneous units are established within which always the same operations are performed. Business processes follow criss-cross lines between the units (Van Hootehem, 2000). Division by function can also be observed between organisations, for example when an organisation contracts out certain services, like IT or accounting.

Division by product (or service), brings together in one unit all operations involved in the production and marketing of a specific product or service (or a related group of products or services), all operations regarding a certain geographic region, or all operations dealing with a certain type of customer. Unlike a functional department, a division by product resembles a separate business (Stoner et al., 1995). Division by product implies that the business processes for the various products or services take the form of parallel streams. All operations are grouped in connection with those streams (Van Hootehem, 2000). At the inter-organisational level, division by product can result in integration of all business process steps within the individual organisation, for example when separate car plants each produce a certain car model. But it could also imply that organisations serving the same type of customer or geographic region work together by integrating their efforts in one product or service.

3.2 Inter- and intra-organisational division of labour

A growing number of business processes cross the boundaries of the individual organisation, and these are often referred to as “value chains” (Van Hootehem and Huys, 2007; Ramioul, 2006). Such an inter-organisational division of labour can be done by function - by bundling similar functions (like ICT) in separate organisations - or by product (or service) - by making every organisation responsible for a certain product or service, or for a specific target group of customers.

To a certain extent, organisations define their own boundaries, by their make-or-buy decisions, referring to the strategic choice between creating a product or service internally (in-house) or buying it externally (from an outside supplier). However, especially in the public

sector, the boundaries of an organisation are based on other decisions, which are often not made by the individual organisation. The allocation of tasks and competences is not only based on economic criteria, but also on political principles, like the assurance of democratic control.

The inter-organisational division of labour defines the tasks and operations that have to be done within a particular organisation, and thus limits the options regarding the intra-organisational division of labour. The radical implementation of each of the two forms of labour division within an organisation results in two antipodal organisational models, or ideal types: (1) the bureaucratic model, and (2) the flexible model (Van Hootehem et al., 2008).

The bureaucratic model is primarily aimed at the internal efficiency control of the separate tasks. The dominant construction principle is a far-reaching division of labour. Tasks are split up into routine jobs. Similar activities are bundled in a department or section. By now, the principles of bureaucratic division of labour have pervaded all economic sectors, including the service sector and the public sector.

The structure of the flexible model is based on the streams of production. Every business process, in which a certain demand of a customer is converted to an answer, a product or a service, is kept together as much as possible. This decreases the number of organisational transitions in the complete process.

3.3 Concepts to describe the division of labour

In this subsection, concepts to describe the division of labour are derived from 3 theoretical approaches: (1) the Modern Socio-technical Systems Approach, (2) the Transaction Costs Approach and (3) the Social Network Theory.

First, the Modern Socio-Technical Systems (MSTS) approach, merely developed and applied in the Netherlands as a framework for the analysis and design of organisations (van Amelsvoort, 2000; de Sitter et al., 2000; van Eijnatten, 1993), states that the organisational structure creates the necessary and boundary conditions to meet the environmental demands. Functionally divided business processes are expected to have problems handling demands for flexibility, while product-oriented structures are expected to perform better.

Second, each division of labour, within or between organisations, will generate a certain transaction cost (Williamson, 1981). As long as the business process is simple and standardised, and the transactions can easily be codified, the transaction costs associated with a functional division of labour could be manageable. If, however, the business process has to operate in a more complex environment, and is faced with high demands for flexibility, the transaction costs for coordination may strongly increase. A product (or service) based division of labour could reduce the transaction costs by grouping the tasks related to the production of a specific product or service together in an organisational unit. In that way, the concept of transaction costs helps to explain how choices about the division of labour could influence the performance of the business processes.

Third, the division of labour results in an organisational structure that can be viewed as a social network (van Amelsvoort, 2000). Social network theory (Barnes, 1954; Granovetter, 1973) views social relations in terms of nodes and ties. The nodes are the individual actors (e.g. organisations) within the networks, and the ties are the relationships between the actors (e.g. information exchange). So, a social network is a social structure made of nodes that are tied by one or more specific type of interdependency. Rather than treating individuals (i.e. persons, organisations, states...) as discrete units of analysis, social network theory focuses on how the structure of ties affects individuals and their relationships. Based on social

network theory, the organisational structure of the network of business processes can be expected to have an impact on the ability of the nodes to meet certain external demands.

3.4 The impact of changing environmental demands

A business process is an open system, which interacts with its environment (Daft, 2001; Desmidt and Heene, 2005; van Eijnatten, 1993). The environment can be described in terms of the external demands which are put on the business processes, like efficiency or reliability. As the environment changes, so must the business process. There has been a general evolution in the public sector towards more autonomy, and a following search for suitable ways to renew coordination between the autonomous units (Verhoest et al., 2007). Because of this evolution, economic demands became gradually more important for the public sector. In the economic field, during the last decades, demands for flexibility, innovation and sustainability were added to the classical demands for efficiency and quality (Bolwijn and Kumpe, 1991; Van Hootegem et al., 2008). In addition, information use and exchange becomes more important in modern society (Castells and Himanen, 2002), which also raises the need for flexibility. The growing number of SDI-initiatives are themselves an illustration of this evolution. Given these environmental changes, and based on the theoretical approaches that were discussed in the previous subsection, bureaucratic and functionally divided (inter-) organisational forms are expected to have problems handling these demands, while product-oriented, network-based (inter-) organisational forms are supposed to perform better.

4. ORGANISATIONAL STRUCTURES AND SDI PERFORMANCE

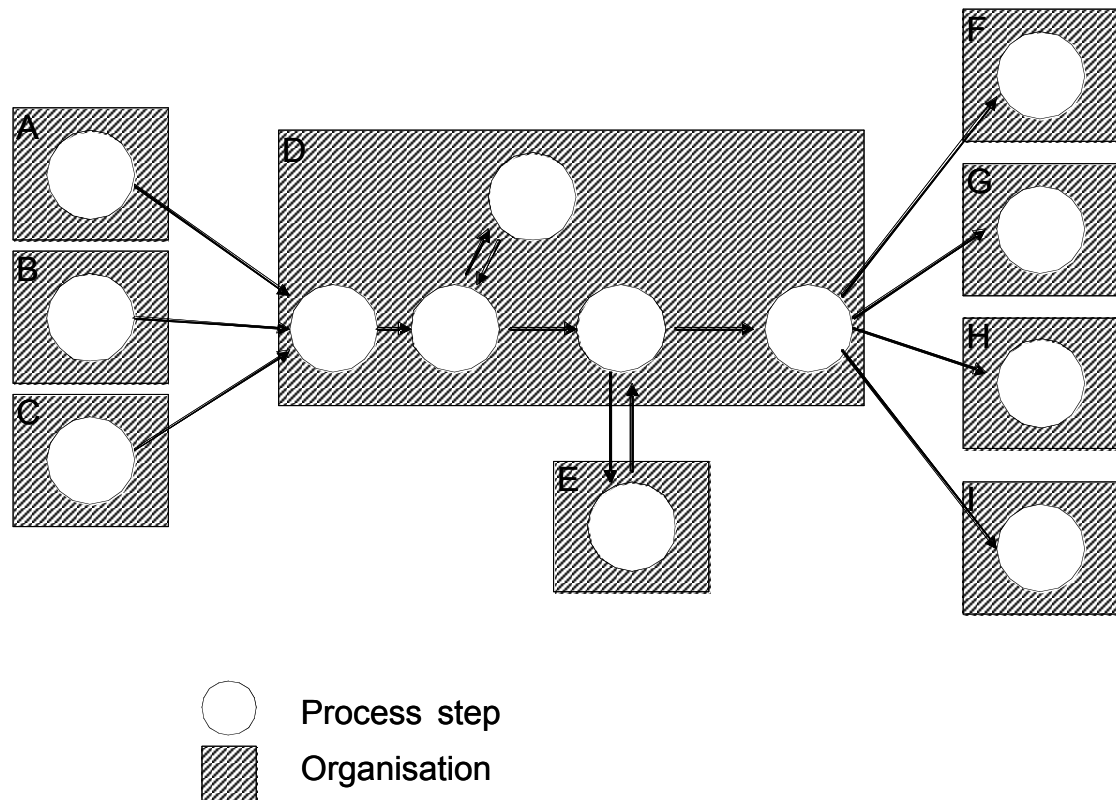
By linking SDI to business processes, SDI is connected to how business processes are divided and coordinated. Arguably, the aspect of organisational structures is a more fundamental side to infrastructures than other aspects, such as human resource issues, technological issues, or legal aspects. Yet especially the connection to organisational structures is systematically ignored in studies of the organisational side to SDI.

Although general SDI goals can be defined at, for example, a national level, actual SDI performance can in fact only be measured at the level of the business processes, in which spatial data is accessed, used and shared. To assess this performance, an insight is needed into the relation between SDI and other infrastructural elements that could play an important role. Based on the theoretical approaches that were presented in the previous section, the focus of our research will be on organisational structures, both within and between organisations. This founded choice implies that other infrastructural elements, like recruitment and selection of personnel, or training and education policy, are not dealt with in the study. But, based on the general evolution, which puts growing demands for flexibility on the business processes, choices regarding the division of labour, and resulting in certain organisational structures, are expected to be crucial factors to explain SDI performance.

An example may help to clarify these concepts. Figure 1 provides a schematic overview of the different steps in the inter-organisational business process of making a spatial implementation plan at local government level. The figure shows that certain steps take place within the same organisation, while other steps cross the organisational boundaries. Organisation A, B, C and D are sources for spatial and other data which is needed in the planning process. Within the local government administration (D) several steps can be distinguished: first, the data is collected by a GIS department, which passes it on to the spatial planner. This spatial planner consults the legal department of his organisation, before passing the draft plan to his GI operator. Since the actual GIS-analyses and mapmaking are outsourced to a consulting firm (E), several transactions occur between the GI operator and the consulting firm, before the plan is ready. Finally, the plan is transferred to the communication department, where it is made available to other organisations (F,G,H,I) for further use. Please notice that the actual business process of spatial implementation

planning involves many more steps, like a public participation phase, and the decision by the local government council. But this simplified example shows how different steps in an inter-organisational business process can be distinguished. The characteristics of the resulting organisational structures can then be related with (1) the access, use and sharing of spatial data in the different steps of the process, and (2) the contribution of this spatial data access, use and sharing to the business process performance.

Figure 1 : business process scheme



5. CONCLUSION

This paper has considered a number of organisational issues relating to the integration of spatial data access, use and sharing in the business processes. It showed that the structural dimension of organisations and their business processes could have a fundamental impact on SDI performance. Based on this theoretical considerations, following hypothesis regarding the influence of (inter-)organisational structures on SDI performance are formulated:

1. Different types of division of labour will present different outcomes regarding the level of spatial data access, use and sharing, and the ability to integrate the spatial data flows in the processes for a higher process performance.
2. A product-oriented division of labour, both at the intra- and inter-organisational level, can be linked to high SDI performance.
3. Function-oriented divisions with high transaction costs can nevertheless lead to high SDI performance, under the express condition that the appropriate coordination efforts are made.

4. The impact of the division of labour is influenced by the environmental demands. Although in general business processes are increasingly faced with demands for flexibility, this is not necessarily the case for every business process.

5. The impact of the division of labour is influenced by the position the business process occupies in the broader network of business processes. SDI performance could, for example, be low, due to the fact that the particular business process is of only marginal relevance to the core business processes of the organisation involved.

These hypotheses will be tested in a series of case studies in 2009, which will be performed in the context of 'SPATIALIST', a multi-disciplinary research project on SDI and public sector innovation in Flanders (Belgium) (Crompvoets et al., 2008).

REFERENCES

- Akinyemi, F. O. (2007). "Spatial data needs for poverty management", in: H. Onsrud (Ed.) *Research and theory in advancing spatial data infrastructure concepts*, Redlands, CA: ESRI Press, pp. 261-277.
- Barnes, J. (1954). Class and committees in a Norwegian island parish, *Human Relations*, 7: 39-58.
- Bekkers, V. and R. Moody (2006). "Geographical information and the policy formulation process: the emergence of a reversed mixed scanning mode?", in Bekkers V., van Duivenboden, H. and M. Thaens (Eds.). *Information and communication technology and public sector innovation*. Amsterdam: IOS Press, pp. 103-120.
- Bolwijn, P. and T. Kumpe (1991). *Marktgericht ondernemen: management van continuïteit en vernieuwing*, Assen: Van Gorcum / Stichting Management Studies. [in dutch]
- Campbell, H. and I. Masser (1995). *GIS and organizations. How effective are GIS in practice?* London: Taylor and Francis.
- Castells, M. and P. Himanen (2002). *The information society and the welfare state*. Oxford: Oxford University Press.
- Chan, T. O. and I. P. Williamson (1999). "Spatial data infrastructure management: lessons from corporate GIS development", *Aurisa 99, November 22-26 1999, Blue Mountains, New South Wales*.
- Coleman, D., Groot, R. and J. McLaughlin (2000). "Human resource issues in the emerging GDI environment", in Groot, R. and J. McLaughlin (Eds.). *Geospatial data infrastructure. Concepts, cases and good practice*. Oxford: Oxford University Press. pp. 236-244.
- Craglia M. and M. Campagna (2009). *Advanced regional spatial data infrastructures in Europe*. Luxembourg: Office for official publications of the European Communities.
- Craig, W. J. (2005). White knights of spatial data infrastructure: the role and motivation of key individuals. *URISA journal*, 16 (2): 5-13.
- Crompvoets, J., Bouckaert, G., Vancauwenberghe, G., Vandenbroucke, D., Van Orshoven, J., Janssen, K. et al. (2008). "Interdisciplinary research project: SPATIALIST. Spatial Data Infrastructures and Public Sector Innovation in Flanders (Belgium)", *GSDI-10 Conference, Trinidad: St. Augustine*.
- Daft, R. L. (2001). *Organization theory and design*. Saint-Paul: South-Western College Pub.

- de Man, E. (2003). Cultural and institutional conditions for using geographic information. *URISA journal*, 15 (1): 29-33.
- de Man, E. (2007). "Are spatial data infrastructures special?", in Onsrud H. (Ed). *Research and theory in advancing spatial data infrastructure concepts*. Redlands: ESRI Press, pp. 33-54.
- de Sitter, L.U., Naber, J.L.G. and F.O. Verschuur (2000). *Synergetisch produceren: Human Resources Mobilisation in de produktie: een inleiding in structuurbouw*. Assen: Van Gorcum. [in dutch]
- Desmidt, S. and A. Heene (2005). *Strategie en organisatie van publieke organisaties*. Tiel: Lannoo. [in dutch]
- Douglas, M. (1978). *Cultural bias*. London: Royal Anthropological Institute of Great Britain and Ireland.
- Fernández, T. D., Lance, K., Buck, M. and H. Onsrud (2006). "Assessing an SDI readiness index", *From Pharaohs to Geoinformatics. FIG Working Week 2005 and GSDI-8, April 16-21 2005, Cairo, Egypt*.
- Giddens, A. (1984). *The constitution of society: outline of the theory of structuration*. Berkeley, CA: University of California Press.
- Granovetter, M. (1973). The strenght of weak ties. *American Journal of Sociology*, 78 (6): 1360-1380.
- Harvey, F. and D. Tulloch (2006). Local-government data sharing: Evaluating the foundations of spatial data infrastructures. *International Journal of Geographic Information Science*, 20 (7): 743-768.
- Koerten, H. (2008). "Assessing organisational aspects of SDI's", in Cromptoets, J., Rajabifard, A., Van Loenen, B. and T. D. Fernández (Eds.) *A multi-view framework to assess spatial data infrastructures*. Melbourne: The Melbourne University Press, pp. 235-254.
- Latour, B. (2007). *Reassembling the social: an introduction to actor-network-theory*. Oxford: Oxford University Press.
- Nebert, D.D. (Ed) (2004). *The SDI cookbook*. Version 2.0. GSDI-Technical Working Group.
- Masser, I. (2005). *GIS Worlds. Creating Spatial Data Infrastructures*. Redlands: ESRI Press.
- Masser, I. (2006). What's special about SDI related research? *International Journal of Spatial Data Infrastructures Research*, 1: 14-23.
- McDougall, K., Rajabifard, A. and I.P. Williamson (2007). "A Mixed-Method Approach for Evaluating Spatial Data Sharing Partnerships for Spatial Data Infrastructure Development", in Onsrud H. (Ed.). *Research and Theory in Advancing Spatial Data Infrastructure Concepts*. Redlands: ESRI Press, pp. 55-73.
- Nedovic-Budic, Z., Feeney, M.-E. F., Rajabifard, A. and I.P. Williamson (2004). Are SDIs serving the needs of local planning? Case study of Victoria, Australia and Illinois, USA. *Computers, Environment and Urban Systems*, 28: 329-351.
- Nedovic-Budic, Z. and J.K. Pinto (2001). Organizational (soft) GIS interoperability: lessons from the U.S. *International Journal of Applied Earth Observation and Geoinformation*, 3 (3): 290-298.
- Nedovic-Budic, Z., Pinto, J. K. and N.R. Budhathoki (2008). "SDI effectiveness from the user perspective", in Cromptoets, J., Rajabifard, A., Van Loenen, B. and T. D. Fernández (Eds.). *A multi-view framework to assess spatial data infrastructures*. Melbourne: The Melbourne University Press.

- Omran, E.-S. E. (2007). *Spatial data sharing: from theory to practice*. Enschede: Wageningen Universiteit.
- Omran, E.-S. E. and J. Van Etten (2007). Spatial data sharing: applying social network analysis to study individual and collective behavior. *International journal of geographical information science*, 21 (6): 699-714.
- Rajabifard, A. (2003). "SDI Diffusion - a regional case study with relevance to other levels", in Williamson, I.P., Rajabifard A. and M.-E. F. Feeney (Eds.). *Developing Spatial Data Infrastructures. From concept to reality* London / New York: Taylor and Francis, pp. 94-40.
- Rajabifard, A., Feeney, M.-E. F. and I. P. Williamson (2002). Future directions for SDI development. *International Journal of Applied Earth Observation and Geoinformation*, 4 (1): 11-22.
- Rajabifard, A., Feeney, M.-E. F. and I.P. Williamson (2003a). "Spatial Data Infrastructures: concept, nature and SDI hierarchy", in Williamson, I.P., Rajabifard, A. and M.-E. F. Feeney (Eds.). *Developing Spatial Data Infrastructures. From concept to reality* London / New York: Taylor and Francis, pp.17-40.
- Rajabifard, A., Feeney, M.-E. F., Williamson, I. P. and Masser, I. (2003b). "National SDI initiatives", in Williamson, I.P., Rajabifard, A. and M.-E. F. Feeney (Eds.). *Developing Spatial Data Infrastructures. From concept to reality*. London / New York: Taylor and Francis, pp. 95-109.
- Ramioul, M. (2006). "Organisational Change and the Demand for Skills", in Huws, U. (Ed). *The transformation of work in a global knowledge economy: towards a conceptual framework*. Leuven: Katholieke Universiteit Leuven: Higher Institute of Labour Studies, pp. 97-118.
- Reeve, D. and J. Petch (1999). *GIS, Organisations and People: A Socio-technical Approach*. London: Taylor and Francis.
- Rogers, E. (2003). *Diffusion of innovations*. (5 Ed.) New York: Free Press.
- Stoner, J.A.F., Freeman, E.R. and D.R. Gilbert (1995). *Management - sixth edition*. Englewood Cliffs, USA: Prentice Hall inc.
- van Amelsvoort, P. (2000). *The design of work and organisation. The modern sociotechnical systems approach*. Vlijmen: ST-Groep.
- van Eijnatten, F. M. (1993). *The paradigm that changed the work place*. Assen: Van Gorcum.
- Van Hootegem, G. (2000). *De draaglijke traagheid van het management: Tendensen in het productie- en personeelsbeleid*. Leuven: Acco. [in dutch]
- Van Hootegem, G. and R. Huys (2007). "Onderweg naar POST-moderne sociotechniek. Slank of slagvaardig?", in Dhondt, S. and F. Vaas (Eds.). *Waardevol werk: Van arbeidskwaliteit naar sociale innovatie*. Hoofddorp: TNO Kwaliteit van Leven, pp. 177-186. [in dutch]
- Van Hootegem, G., van Amelsvoort, P., Van Beek, G. and R. Huys (2008). *Anders organiseren & beter werken. Handboek sociale innovatie en verandermanagement*. Leuven: Acco. [in dutch]
- Van Loenen, B. and E. van Rij (2008). "Assessment of Spatial Data Infrastructures from an organisational perspective", in Cromptoets, J., Rajabifard, A., Van Loenen, B. and T. D. Fernández (Eds.). *A multi-view framework to assess spatial data infrastructures*. Melbourne: University of Melbourne. pp. 173-192.
- Vandenbroucke, D. and K. Janssen (2008). *Spatial Data Infrastructures in Europe: State of Play 2007*. Leuven, Belgium.

- Verhoest K., G. Bouckaert and G. Peters (2007). Janus-faced reorganization: Specialisation and coordination in four OECD countries in the period 1980-2005. *International Review of Administrative Sciences*, 73 (3): 325-348.
- Vonk, G., Geertman, S. and P. Schot (2007). New Technologies Stuck in Old Hierarchies: the Diffusion of Geo-Information Technologies in Dutch Public Organizations. *Public Administration Review*, 67 (4): 746-756.
- Wehn de Montalvo, U. (2003). In search of rigorous models for policy-oriented research: a behavioral approach to spatial data sharing. *URISA journal*, 15 (1): 19-28.
- Williamson, O. E. (1981). The economics of organization: the transaction cost approach. *American Journal of Sociology*, 87 (3): 548-577.