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A Multidisciplinary Research Framework for Analysing the Spatial Enablement of Public Sector Processes*

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Abstract

Although Spatial Data Infrastructure (SDI) is a complex concept with many facets, it is widely recognised that SDIs are about facilitating and coordinating spatial information flows. This paper argues that the analysis of spatial information flows should not be separated from the processes in which they are embedded. The paper presents the development of a multidisciplinary research framework to

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study the spatial enablement of public sector processes, and the application of this research framework in a case study on zoning planning in Flanders (Belgium). The paper demonstrates the applicability of the proposed research framework for enhancing our understanding of factors that may influence the role of spatial information in public sector processes. The identification of these decisive factors may contribute to the further advancement of SDI as an enabling platform.

Keywords: Spatial enablement, SDI, multidisciplinary research, case study

1. INTRODUCTION

Spatial Data Infrastructures (SDIs) have been developed in many countries worldwide to support the generation of spatially-enabled societies (Rajabifard, 2007a). An SDI is typically defined as a set of interacting resources for facilitating and coordinating spatial data access, use and exchange (Rajabifard et al., 2002; Nedovic-Budic et al., 2008). Alongside SDI development activities, various research initiaves have been deployed in order to understand (specific aspects of) the SDI phenomenon. Nedovic-Budic et al. (2011b) provide a thorough overview of previous SDI research output. It is certainly no longer correct to state that an SDI is regarded as a mainly technological project. Recent books such as Onsrud (2007), Rajabifard (2007b), Crompvoets et al. (2008) and Nedovic-Budic et al. (2011b) deal with a large number of (inter-)organisational, institutional, cultural, legal and economic factors influencing spatial data access, use and sharing, in addition to the technological factors. Although the importance of a multidisciplinary approach to SDI is clearly recognised, the treatment of the different factors is often highly fragmented. An integrated model is usually lacking, although Onsrud and Rushton (1995), Rajabifard (2003) and Rodriguez Pabon (2005) have tried to combine several factors in a comprehensive model. More integrated approaches can also be found in the general literature about data infrastructures. Landsbergen and Wolken (2001) deal with factors which can constitute barriers to information sharing between government organisations. Bekkers (2009) discusses factors which affect the flexibility of an e-government infrastructure. However, in the field of SDI, research output that explicitly requires empirical testing of multidisciplinary theoretical approaches and systematically adresses the contextual elements is still scarce (Nedovic-Budic et al., 2011a). Furthermore, relatively few SDI evaluation studies consider performance from the user's perspective. The ongoing evaluation research is still more concerned with access to spatial data than with use and utility of the infrastructure, although gradually the call for user-centered SDIs grows louder (Nedovic-Budic et al., 2008).

Since an SDI is about facilitating and coordinating spatial data access, use and exchange, the infrastructure is dealing with data and, eventually, information flows (Dessers et al., 2011b; Vandenbroucke et al., 2012). The data-centred facilities offered by SDI will therefore only become meaningful once they are used to generate and use information. The connection to information points to the need to study SDI in relationship to the context of SDI use. We argue that a generic concept for introducing this link can be found in the concept of *processes*. A *process* is the sequence of steps involved in producing products and services (Daft, 2001; Desmidt and Heene, 2005). It usually takes the form of a series of interrelated activities, which turn a certain input of resources into an output of products or services. Process performance then refers to these products and services in connection to what is expected from them by their users and society at large. Processes are defined as spatially enabled, when there is a high performing integration of spatial information flows in these processes (Dessers et al., 2010). Spatial information flows and the processes involved should best be analysed together (Vandenbroucke et al., 2009). Both are intertwined, and so is their performance (de Sitter, 2000).

Information is not flowing in the void, but instead it is running through a network of processes. The relevance of the information flows depends on their significance for these processes (Daft, 2001). The key question is then which factors might impact the performance of both processes and their spatial information flows. The process defines the setting in which SDIs become effective (Dessers et al., 2010). What an SDI should or should not do and what it can and cannot do may be heavily influenced by the characteristics of the process and its context.

A concrete process may be confronted with SDI initiatives at various administrative levels, from European to local. These SDI initiatives confront the process with both general SDI measures (such as the establishment of a central metadatabase) and SDI measures which are specific to the process (such as the compilation of a technical exchange guideline, or the setting up of a consultation structure for a specific policy domain). These SDI measures attempt to act on the factors that have an impact, either positive or negative, on spatial data access, use and sharing (Onsrud and Rushton, 1995). In this research, this set of relevant factors is called the *process configuration*. The *spatial enablement* of the process refers to the extent to which access, use and exchange of spatial information is an integrated part of the process, and to which degree this contributes to overall process performance. The research aims to examine the impact of the process configuration on the spatial enablement of concrete public sector processes. The aim of this paper is to present and discuss the applicability of the multidisciplinary framework that was developed to tackle this research question. The identification of relevant process configuration factors might help future SDI initiatives in tackling the connected issues, in order to further promote and facilitate the spatial enablement of public sector processes. The paper discusses one case of a public sector process: the production of zoning plans, aimed at the spatial development of specific areas.

The rest of this paper is organised as follows. Firstly, the multidisciplinary research framework is presented. Next, the application of the research framework in the case study on zoning planning is described. The final section concludes by discussing the results of the study, the application of the research framework and the possible implications for further SDI-related research.

2. RESEARCH FRAMEWORK

Since the research aims to examine the impact of the process configuration on the spatial enablement of concrete public sector processes, the process was chosen as the unit of analysis of the present research. The research focuses on processes in the public sector, for three reasons: (1) SDI initiatives are generally launched by organisations from the public sector (Masser, 2005). (2) Most information that is used within the public sector can be linked to a location (Longhorn and Blakemore, 2008). The potential benefits for the public sector of properly functioning SDIs can therefore be considerable (Masser et al., 2007). (3) Finally, the availability of clear and accurate government information is also very important to organisations outside the public sector, and to the individual citizen (Longhorn and Blakemore, 2008; Stiglitz, 1999).

First the case study approach is substantiated. Next, the conceptual research model is presented, and finally the operationalisation of this conceptual research model is discussed.

2.1. Case Study

The research aims to analyse thoroughly whether, how and why differences in current process configurations affect the spatial enablement of these processes. Case-based research is a widely used method for studying complex contemporary phenomena in their actual context (Yin, 2003). A case study is an intensive examination of one or more cases taking into consideration the context, the complexity of reality, and the multiple issues that might have an impact on the subject studied. In this research, the link between process configuration and spatial enablement as a phenomenon is the topic of analysis. Selected processes serve as cases to investigate the link between the associated process configuration and spatial enablement.

In this research, a case is defined as a process between and within public sector organisations in which spatial data are accessed, used and shared. The research area is the Flanders region in Belgium. The number of cases is set at four: 1) the development of zoning plans, 2) the registration and processing of traffic accidents data, 3) the management of address data and 4) the mapping of flood areas. Note that the four selected processes are considered to be suitable cases because of their expected variety in process configuration. It is clear that other processes within the public sector might as well have been appropriate for being selected as a case. What matters most is that the four selected cases allow the examination of the relation between process configuration and spatial enablement.

A detailed investigation of the four processes, and of the role of spatial data within them is necessary. Since the organisations involved are the key actors in the different processes, such an investigation can only be achieved by gathering information from concrete organisations that are part of the process. Within each of the cases, six to eight key organisations were therefore selected, which are called the ‘embedded cases’ (Yin, 2003).

The relation between process configuration and spatial enablement is studied at two levels. 1) At the embedded case level, a comparative analysis is made of the embedded cases, seperately for each of the four cases. This analysis should allow to link differences in process configuration between the organisations that were selected as embedded cases within one of the cases to their respective level of spatial enablement. This comparison might help to explain why organisations show different levels of spatial enablement with regard to the same process. 2) At the case level, a comparative analysis of the four cases is conducted, aimed at analysing the possible relation between the larger, inter-organisational process configuration and the spatial enablement of the inter-organisational process as a whole. The focus of the present paper is limited to the embedded case level.

2.2. Conceptual Research Model

The process configuration as examined in this research is interpreted in a way that is multidisciplinary and integrated. Although a number of case study research designs can be found in SDI and GIS literature (for example: Nedovic-Budic, 1997; Pornon, 2004; Bekkers and Moody, 2006; Koerten, 2008), a made-to-measure research framework is needed to allow the researchers from the five disciplines involved to study the relation between process configuration and spatial enablement, in such a way that their disciplinary research data could be combined in a multidisciplinary way.

In view of the diversity of factors, the research combines theories and research models from various disciplines. Researchers from the following disciplines are involved: geomatics, public management, sociology of organisations, law, and economics. On the basis of a study of the literature and earlier research, the following sections explain for each discipline which factors are examined. Moreover, the different disciplinary approaches are integrated in the description of the process configuration for a specific process. This configurational approach includes a systematic and holistic view, in which it is not so much individual factors, but configurations of factors that are linked to spatial enablement. The configurational approach is based on the work of Ragin (2000) and Fiss (2007). Configurational analysis stresses the concept of equifinality: the same end result can be achieved via different routes. Factors which play a role in one configuration may be irrelevant in another.

Figure 1: Conceptual Research Model

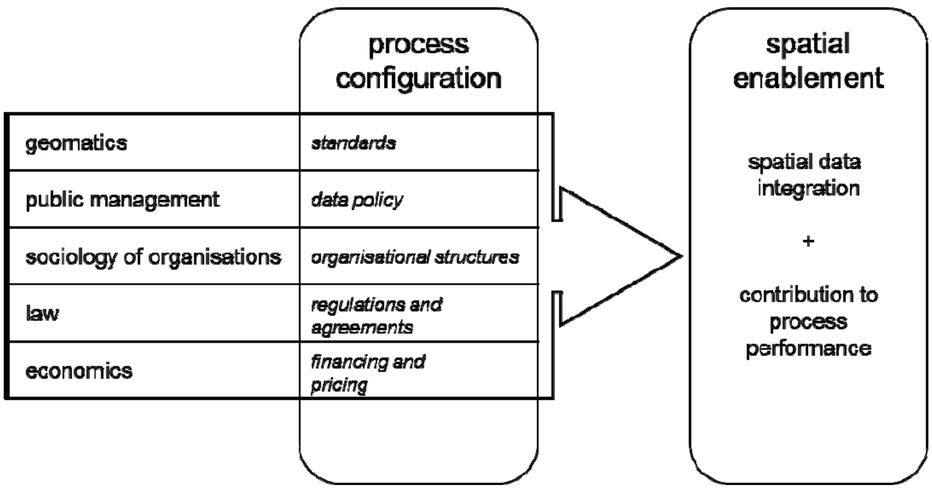


Figure 1 shows the main concepts and their interconnections in the conceptual research model. On the left side of the figure, the involved disciplines are placed. Each discipline investigates a factor that may affect the level of spatial enablement of a concrete process. These factors are standards, data policy, organisational structures, regulations and agreements, and financing and pricing. The process configuration is the totality of all these factors together.

(1) *Standards* is proposed as key process configuration factor by the geomatics discipline. The technological aspects of an SDI embrace various components (Nebert, 2004; European Commission, 2007): the spatial data, the metadata, and the various tools and software that makes it possible to view, query, process and analyse the spatial data. For making the components work together, the application of standards is of utmost importance (Croswell, 2000; van Oosterom, 2005; Open Geospatial Concortium (OGC), 2011). The focus of the geomatics

discipline is primarily on the application of geo-standards related to the development and application of data specifications (models), the creation and use of metadata, the access mechanisms and the exchange formats. It is expected that the application of ((inter)national) geo-standards has a positive effect on the spatial enablement of the process.

(2) *Data policy* is proposed as key process configuration factor by the public management discipline. The shaping of a data policy can be regarded as a question of coordination, or as the bringing into alignment of separate activities or events (Thompson et al., 1991; Vancauwenberghe et al., 2011). After all, different services, organisations and administrative levels are involved in the production, use and sharing of spatial data and each one has competence for and specialises in one or more tasks. Coordination can occur via direct control (hierarchy), via competition (market) or via mutual collaboration (network) (Verhoest et al., 2003). Specific advantages and disadvantages are ascribed to each of these forms of coordination (Powell, 1990; Verhoest et al., 2003).

(3) *Organisational structures* is proposed as key process configuration factor by the sociology discipline. Whereas public management focuses on the coordination in (spatial) data policy, it is argued here that the task allocation and coordination in the process itself, and the general task allocation and coordination within and between the organisations concerned constitutes part of the process configuration. An organisational structure can be defined as the sum of the ways in which the production of a good or service is divided into distinct tasks, and the coordination is achieved among these tasks (Mintzberg, 1993). Two basic structuring forms can be distinguished. (1) A function-based structure subdivides processes into separate tasks, which are performed by specialised organisational units. (2) A process-based structure keeps all activities related to the production of a certain product or service, or related to a specific target group or area, together in one multi-functional organisational unit. Based on organisation theory (de Sitter, 2000; Achterbergh and Vriens, 2009) and previous research (for example: Van Hootegem, 2000), it is hypothesised that, given the level of complexity and dynamism of the current social environment, process-based organisational structures may provide a better option to reach a high performing integration of spatial information flows in processes (Dessers et al., 2011b).

(4) *Regulations and agreements* is proposed as key process configuration factor by the law discipline. Spatial data access, use and sharing of spatial data are subject to legal rules. These rules, and the way in which they are applied, may either stimulate or impede such access, use and

sharing (Janssen and Dumortier, 2007; Janssen, 2010). On the one hand, rules promoting the functioning of an SDI include regulations concerning freedom of information, the reuse of government information, data sharing (e.g. the SDI decree) and the mandatory use of data in certain processes (e.g. authentic sources). On the other hand, some rules create barriers for the use of spatial data in particular policy processes or for the provision of particular services by the public sector (Onsrud et al., 2004; Masser, 2006). While there are many different legal aspects that play a role in the development of an SDI, this research focuses on the legal conditions, possibilities and restrictions relating to spatial data access, use and sharing in the context of the selected processes.

(5) *Financing and pricing* is proposed as key process configuration factor by the economics discipline. The economic issues regarding spatial data access, use and sharing can be divided into two parts: the pricing of spatial data, and the financing of the process (Giff and Coleman, 2003). The pricing of spatial data is analysed from the viewpoint of the users. Next to the cost of the spatial data that are needed in the process, also the price setting of the spatial data that emerge from the process is considered. The pricing of spatial data is thus examined on the input side and on the output side (Longhorn and Blakemore, 2003). The second economic component is the financing of spatial data. This involves the financial resources that are necessary to support the different activities of the various organisations. In this study, mainly the external financing is examined (Crompvoets et al., 2009). The effectiveness and efficiency of these economic aspects thus may have an important influence on the extent to which spatial data can be acquired, used and distributed.

The selection of five disciplinary factors implies a complexity reduction. This step is necessary, since the reality is just too complex to envisage in its entirety. In this respect, the design of a map might be a suitable metaphor (Kuipers et al., 2010). A map is always a representation of a selection of elements from the real world (e.g. the roads), while omitting many other elements. Besides, the framework of a map depends on its purpose. While the purpose of a road map is helping travellers to reach their destination, the purpose of the process configuration concept in the present study is to investigate whether the selected factors might have an impact on the spatial enablement of a process.

On the right side of Figure 1, the spatial enablement of the process is placed. The concept of spatial enablement is introduced here to describe the realisation of SDI objectives in the context of individual processes. Rajabifard et al. (2010) state that the spatial enablement concept is applicable to many fields: data, people, services, organisations, markets, governments and societies can all be spatially enabled. The essence of the spatial enablement concept may be described as facilitating the realisation of objectives through spatial information. Spatial enablement refers to the access to and incorporation of spatial data needed to make spatial or location-specific decisions (Rajabifard et al., 2010). According to this line of reasoning, processes can be defined as spatially enabled, when there is a high performing integration of spatial information flows in these processes (Dessers et al., 2010). In this regard, Williamson et al. (2007) pointed out that governments are not using spatial technologies to improve processes, which is regarded as the spatially enabled government research problem by Holland et al. (2010).

Spatial enablement encompasses two aspects, as shown in Figure 1. First, *spatial data integration* reflects the idea that an SDI should facilitate spatial data access, use and sharing (Masser, 2010; European Commission, 2007). A smooth access to the needed spatial data, an intense use of spatial data in the different steps of the process, and a ready availability of the spatial data related to the output of the process, is expected to add to the spatial enablement of that process. Second, *contribution to process performance* refers to whether and to what extent spatial data access, use and sharing contributes to the performance of the process itself. As mentioned in Section 1, the actual goal of SDIs is not to serve the data handling functions per se, but to serve the needs of the user community (Rajabifard et al., 2002). From the perspective of organisations as main stakeholders of SDIs, their actual relevance lies in their contribution to the improved functioning of the organisations and their processes (Dessers et al., 2010).

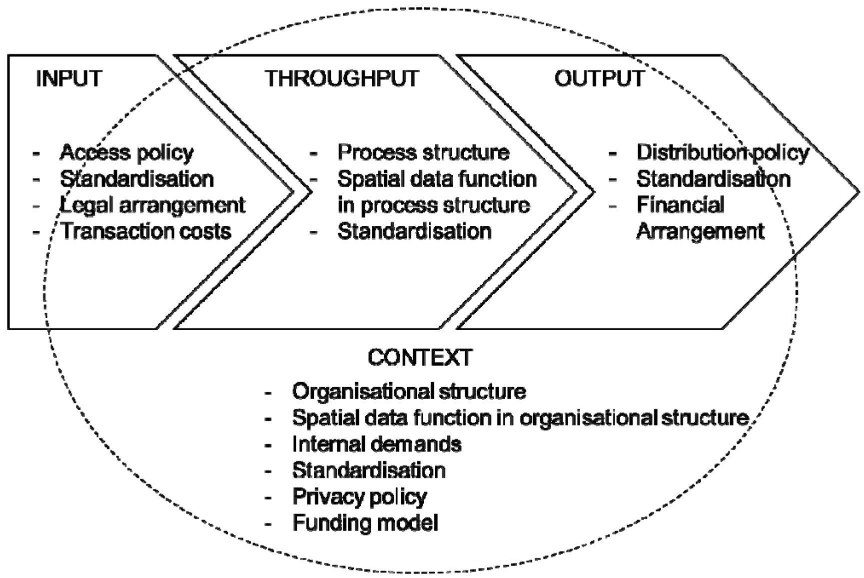
Through analysing both aspects, a comprehensive assessment of the spatial enablement of a specific process is aimed for. In short, spatial enablement refers to the role of spatial data in the process. More information on the assessment methodology can be found in: Vandenbroucke et al. (2012).

2.3. Operationalisation of the Conceptual Research Model

In order to examine the impact of process configuration on spatial enablement in the selected processes, a further operationalisation of the conceptual model is needed.

The five disciplinary factors of the process configuration (Figure 1) are made operational by defining disciplinary variables, which are classified into four multidisciplinary groups: input, throughput, output and context, as can be seen in Figure 2. These groups refer to the three phases of a process, supplemented with the context in which the process takes place (Daft, 2001). It should be noted that each variable is again a generalisation of underlying subvariables or indicators.

Figure 2: Process Configuration Variables



The group *input* describes the input side of the process. The *access policy* variable is related to the policy that organisations pursue for acquiring and accessing spatial data. The variable *degree of standardisation* refers to spatial data access formats, mechanisms and metadata. The variable *legal arrangements* addresses the complexity of the legal arrangements and procedures that have to be followed by the organisation in order to obtain the spatial data it needs for executing the process. The variable *transaction costs* refers to the costs associated with the acquisition of the required spatial datasets.

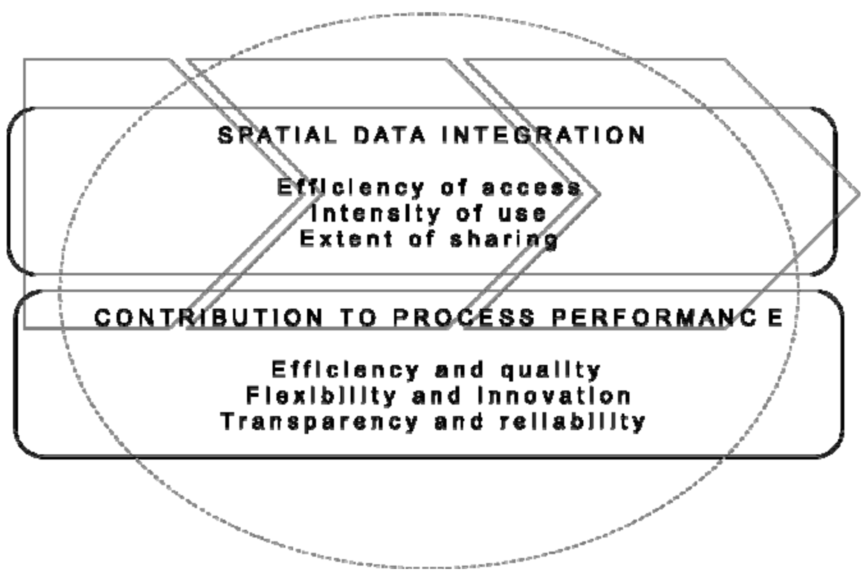
The group *throughput* describes the different steps of the process (such as developing a zoning plan). The variable *process structure* refers to the task division and coordination in the process, including any outsourcing of activities. As this research specifically focuses on the role of spatial data, the extent to which the spatial data related activities are integrated in the process is separately assessed by way of the variable *spatial data function in the process structure*. The variable *degree of standardisation* refers to the application of data models and the creation of metadata in the process.

The group *output* describes the output side of the process. Spatial datasets generated during the process are considered as the output of the process. The variable *distribution policy* refers to the policy of organisations regarding the distribution and provision of the spatial datasets. The variable *degree of standardisation* refers to spatial data delivery formats, mechanisms and metadata. The variable *financial arrangement* refers to the business model and price mechanism that is applied.

The group *context* describes the context in which the process takes place. The variable *organisational structure* refers to the task division and coordination in the organisation. The variable *spatial data function in the organisational structure* refers to allocation and coordination of spatial data related activities in the organisation. The variable *internal demands* refers to the importance of the process with respect to the primary goals of the organisation, and to the political and managerial appraisal of spatial data as a strategic asset. The variable *degree of standardisation* describes the degree to which standards in general are deemed to be important for the organisation.

The application of the process phases (input, throughput and output) and context as categories to group the various disciplinary variables, results in a multidisciplinary description of the process configuration for each embedded case. In order to analyse the relation between process configuration and spatial enablement, also a further operationalisation of spatial enablement is necessary.

Figure 3: Spatial Enablement Variables



As can be seen from Figure 3, spatial enablement is also made operational by defining variables (Vandenbroucke et al., 2012). (1) As for spatial data integration, three variables are used. The variable *efficiency of access* relates to the extent to which it is easy to find the spatial data needed in the process, and to the efforts that are needed before the data can be used in the process. The variable *intensity of use* intends to capture the degree to which spatial data are used in the various steps of the process. The variable *degree of sharing* refers to the extent of the stakeholder group with whom the spatial data resulting from the process are shared in practice, but also to the content of sharing (like static maps, webservices or the actual datasets). (2) Based on performance management literature (Bolwijn and Kumpe, 1990; Bekkers, 1998; Toonen, 2003) three variables were chosen for the operationalisation of contribution to process performance. The values of these variables are based on assessments by process owners and participants. The variable e*fficiency and quality* refers to the decrease of the input of people and means in the process, to the reduction of the lead time, to costs cuttings, to the avoidance of errors and confusion, and to the improvement of the output. The variable *flexibility and innovation* encompasses dealing swiftly with differing requirements and fields of application, quickly adjusting the process when new demands are formulated during the course of the process, or developing multiple alternatives side by side. It also implies changing and ameliorating the proceeding of the process itself, or integrating new technological tools or organisational methods in the process. The variable *transparency and reliability* is about customer-orientedness, offering the exact information a client is searching for, offering the citizen more insight into the proceeding of the process, improving legal security, clarifying the citizen's rights and obligations, offering him ways to control the process and to easily consult the related data and documents.

3. THE ZONING PLANS CASE

3.1. Zoning plans

The development of zoning plans is the first of four processes which are selected as cases in this research. In the Flanders region (Belgium) zoning plans (RWO, 2008) are created in the implementation of spatial structure plans. Three governmental levels are authorised to develop both spatial structure plans and zoning plans: the regional, provincial and municipal level. Each level has delineated powers with regard to spatial planning. Each of these plans is to a large extent the sole responsibility of a single organisation - a local governement, a province, or the regional government - although advices on the draft plan are obtained from other organisations. A zoning plan is generally aimed at the development of a specific area ranging from a single industrial parcel to an entire city district.

The (potential) role of spatial data in the zoning planning procedures can be divided into four main classes. (1) Spatial datasets can help to gather information on the physical and legal condition of the planning area. (2) The actual plan design can be done in a GIS (or CAD) environment based on digital base maps and resulting in a digital (draft) plan. A preliminary draft zoning plan is generally produced in the preparative phase, and is further developed and adjusted throughout the procedure. (3) Zoning plans could be exchanged in digital form at several points in the procedure (RWO, 2008). (4) Finally, the availability of digital zoning plans itself could contribute to the efficiency of other procedures, like building permit delivery and could support the ease of use of the plans by other organisations outside the domain of spatial planning. Furthermore, digital zoning plans could improve the monitoring and evaluation of the spatial planning policies at the different governmental levels, and improve the transparency of these policies towards the citizens (RWO, 2008).

Within the case, a further selection of six organisations was made, in which information was gathered by way of multiple in-depth interviews: the cities of Genk, Kortrijk and Leuven, the provinces of Limburg and West-Vlaanderen, and the Department of Spatial Planning, Housing and Immovable Heritage (RWO) of the Flemish Government. These organisations are called the embedded cases. The process configuration and the level of spatial enablement are described for each embedded case. The embedded case selection was based on two key selection criteria. (1) The resulted selection should provide sufficient information to describe the (inter-organisational) process configuration and spatial enablement of the case in question. Therefore, it is important that the selection includes the main stakeholders of the zoning planning process. (2) The resulted selection should make it possible to investigate the link between process configuration and spatial enablement at the level of the embedded cases (which is the scope of the present paper). In other words, the embedded case selection should also include a certain variety of process configurations in order to analyse the impact of different process configurations on spatial enablement. The selection of the embedded cases was based on information from exploratory interviews and discussions with key stakeholders, consultation of various documents and existing survey results (Dessers et al., 2011a).

3.2. Analysis

Both disciplinary and multidisciplinary analyses of the collected information are made. First, the relation between process configuration and spatial enablement is analysed separately from each of the five disciplinary perspectives. Each discipline first examines the mutual relation between its disciplinary variables describing (part of) the process configuration, and subsequently confronts these variables with the spatial enablement variables. The technique of pattern-matching is used to compare the empirical patterns with those predicted by the disciplinary hypotheses (Yin, 2003). Second, the multidisciplinary relationship between process configuration and spatial enablement is analysed. In order to compare the empirical patterns with those predicted from the conceptual model by pattern-matching, a further data reduction is needed. Data reduction is a form of analysis that sharpens, sorts, focuses, discards, and organises data in such a way that “final” conclusions can be drawn and verified (Miles and Huberman, 1994). This data reduction itself is part of the analysis. In order to compare the process configurations with regard to spatial enablement, the spatial data integration variables and the contribution to process performance variables are reduced to one overall spatial enablement value (i.e. high, medium, low). The multi-category process configuration variables are transformed to Boolean variables. No quantitative measures are applied to identify the threshold for dichotomisation, but instead qualitative knowledge-based criteria are used (Ragin, 1987). As Yamasaki and Rihoux (2009) state, this strategy offers a strong empirical justification given its anchor in case knowledge. For each variable an empirical criterion is defined, which is used to convert the values to a “+” or “-” value. The definition of the threshold is expressly stated for each key variable in the case report (Dessers et al., 2011a). The dichotomised values reflect whether the original variable value of a certain embedded case is higher or lower than the threshold involved. Although this procedure may entail some loss of information, it could contribute to a joint interpretation of the various disciplinary variables.

The dichotomised process configuration variables are then again classified in the input, throughput, output and context groups, and their possible relation with the spatial enablement value is analysed. The results of this analysis are shown in Table 1, in which only the nine process configuration variables are included that seem to be related to spatial enablement.

As can be seen from Table 1, three groups can be identified with regard to spatial enablement. (1) RWO and West-Vlaanderen have a high level of spatial enablement. The combination of efficient data access, intense data use and a high of degree of sharing in the various steps of the zoning planning process makes spatial data an indispensable and integral part of the process. The spatial data contribute not just to efficiency and quality, but also to innovation and flexibility, and to transparency and reliability. (2) Genk and Leuven have a medium level of spatial enablement. Although both cities have a rather high value for efficiency of access, intensity of use and degree of sharing, the use of spatial data mainly increases the efficiency and quality of information management in the zoning planning process, but is not indispensable for the process. (3) Finally, Kortrijk and Limburg have a low level of spatial enablement. In both organisations, the efficiency of access and the degree of sharing of spatial data is low. Also the intensity of use is limited, especially in Limburg. Evidently, also a low contribution to process performance was reported. Spatial data offers little added value compared to paper information, although the potential usefulness in the longer term is recognised.

The following process configuration characteristics might be linked to a high level of spatial enablement.

(1) *A coordinated access policy* (input phase) refers to the policy of the organisations regarding the access to the spatial data that are needed for developing zoning plans. Besides the presence of a coordinating GIS unit, a coordinated access policy may include the implementation of several other instruments to manage and coordinate the internal GIS activities, such as consultation, planning and training.

(2) *An integrated process* (throughput phase) means that the various activities that are needed to develop a zoning plan are not fragmented across multiple organisational units and specialised jobs. In an integrated process, the preparation, support, production and control functions involved are kept together as much as possible. In an integrated process, the spatial planner has a high level of autonomy and a clear responsibility about all steps of the procedure as well as a broad job content. Clustering people in dynamic, team-like structures is then preferred to thematic specialisation as the leading organising principle.

(3) *A spatial data function that is embedded in the process* (throughput phase). The spatial data related knowledge that is needed for the development of zoning plans is then mainly put in the hands of the spatial planners and their assistants, and a dedicated GIS expert may be added to the spatial planning team.

(4) *A marked standardisation* (throughput phase) refers to the application of a data model and to the creation of metadata according to a certain standard. In the zoning plans case, standardisation is about the application of an existing guideline for the digital exchange of zoning plans, and about the standardised documentation of the shared zoning plans.

(5) *A coordinated distribution policy* (output phase). The case study results suggest that a clear procedure for distributing data may be essential. But additional instruments may be needed. Partnerships and cooperation agreements with other organisations seem to prove valuable.

(6) *A marked standardisation* (output phase) refers to the application of dynamic and easily accessible delivery mechanisms (such as webservices) and significant efforts to make the corresponding metadata available.

(7) *Strong internal demands* (context) in this case mainly refers to the political and managerial appraisal of spatial data as a strategic asset, as can be seen from the emphasis on the potential role of spatial data in policy plans, organisational strategies and policy implementation plans.

(8) *A marked standardisation* (context) refers to the availability of a thorough knowledge about general (geo)standards, and to their broad and consistent application within the organisation.

(9) *A fairly open privacy policy* (context) means that the organisation prefers to deal with the obligations stemming from the regulation of the protection of privacy in a rather open way. A very strict privacy policy seems to inhibit the spatial enablement of the zoning planning process. However, caution must be applied, since most spatial data that are used and exchanged in the zoning planning process have no privacy-related characteristics.

Remarkably, the seven remaining variables could not be linked to the spatial enablement of the zoning planning process: the input variables degree of standardisation, legal arrangements and transaction costs; the output variable financial arrangement; and the context variables organisational structure, spatial data function in organisational structure, and funding model. It may be somewhat surprising that none of the three economic process configuration variables are related to spatial enablement. The variable transaction costs (input) involves the actual costs of the required data sets in monetary class terms. Funding model (context) describes how the process is financed. Both variables show very little variation between the six organisations. Only the financial arrangement (output) variable shows some differences, but the results do not provide evidence that a certain business model may lead to a higher level of spatial enablement. The similar economic background of the six embedded cases is probably due to the fact that they are all government organisations. As for the input variable legal arrangements, all embedded cases obtain most of their spatial data sets from the same sources and under the same conditions. As for the input variable degree of standardisation, only the province of West-Vlaanderen and the city of Kortrijk show a marked standardisation. Since the first is part of the high spatial enablement group, and the second of the low spatial enablement group, the variable does not contribute to the explanation of the level of spatial enablement. Finally, two organisational context variables remain. The variables organisational structure and spatial data function in the organisational structure were primarily included in this research to study whether the larger, organisational structure could (partly) account for the process structure. It appears that these variables do not directly correlate with the level of spatial enablement of the process. As expected, the process structure (throughput) seems to be of more importance for explaining the spatial enablement of the process than the larger organisational structure (context).

Although these seven variables seem to add little to the explanation of the differences in spatial enablement in the zoning plans case, they could however play a role in other cases because, for example, there might be larger differences between the embedded cases with regard to the economic and legal variables.

Table 1. The Zoning Plans Case: Process Configuration Variables that may be related to Spatial Enablement

		Criterion (Variable)	RWO	West-Vlaanderen	Genk	Leuven	Kortrijk	Limburg
PROCESS CONFIGURAITON	INPUT	**Coordinated Policy** (Access Policy)	+	+	+	+	-	-
	THROUGHPUT	**Integrated Process** (Process Structure)	+	+	-	-	-	-
		Embedded Spatial Data Function (Spatial Data Function in the Process Structure)	+	+	-	-	-	-
		Marked Standardisation (Degree of Standardisation)	+	+	-	-	-	+
	OUTPUT	**Coordinated Policy** (Distribution Policy)	+	+	-	+	-	-
		Marked Standardisation (Degree of Standardisation)	+	+	-	-	-	-
	CONTEXT	**Strong Internal Demands** (Internal Demands)	+	+	-	-	-	-
		Marked Standardisation (Degree of Standardisation)	+	+	+	-	-	-
		Fairly Open Privacy Policy (Privacy Policy)	*	+	+	+	-	-
SPATIAL ENABLEMENT			**High**	**High**	**Medium**	**Medium**	**Low**	**Low**

(*: missing value)

4. DISCUSSION

The findings of the case study seem to suggest that following characteristics of process configurations contribute to the spatial enablement of the zoning planning process:

(1) a coordinated access policy in the input phase;

(2) an integrated (as opposed to fragmented) process, in which the spatial data function is embedded, combined with a marked standardisation in the throughput phase;
(3) a coordinated distribution policy combined with a marked standardisation in the output phase; and
(4) a context that is characterised by strong internal demands combined with a marked standardisation and a fairly open privacy policy.

At the same time, other characteristics could not be linked to the spatial enablement in the present case. Caution must be applied, since the current analysis was only based on the six embedded cases of the zoning plans case. Three similar case studies will be performed on other public sector processes. The final comparative analysis of the four cases together might help to establish a better understanding on this matter. Different types of processes could imply different process configurations, in which possibly other combinations of variables play a role. There may be no such thing as a single optimal process configuration: rather, multiple configurations may lead to a particular level of spatial enablement. The results of the present report relate in first instance to the role of spatial data in zoning planning. By the investigation of contrasting process configurations in the context of different processes, the potential generalisation of the present case study results could be further examined.

Returning to the aim of this paper to present and discuss the multidisciplinary approach that was applied in this case study, this paper concludes with a critical discussion of the strengths and weaknesses of the methodology, and the possible implications for further research.

As for the strenghts, the key innovative aspect of the research methodology is that a multidisciplinary research team tries to identify technological, organisational, public management, legal, and economic factors related to processes and organisations, which might have an impact on the spatial enablement of public sector processes. Yin (2003) distinguishes four criteria for assessing the quality of case study research: construct validity, internal validity, external validity, and reliability. (1) Construct validity refers to the correct operational interpretation of the concepts being studied. In the research, construct validity was approached in three ways. First, information from multiple sources was used. Within each organisation both management and operational workers, and both substantive and technical specialists were consulted. Moreover, numerous documents were collected, from agreements to policy documents. The combination of the different sources contributes to the construct validity of the research. Second, the so-called chains of evidence were constructed by paying constant attention to the link between the research question, data collection and the analysis. Third, construct validity was reinforced by the presentation of the case reports to all respondents and their discussion during case workshops. Construct validity is not just important in itself. It is also a condition for both internal and external validity. (2) Internal validity applies to all case studies which seek to investigate a causal link. The question is to what extent there is an impact of process configuration on spatial enablement, and to what extent that impact can be ascribed to the process configuration in question (instead of to other factors, or to coincidence). The validity of causal conclusions depends to a large extent on the conclusiveness of the research framework. In this research, the technique of ‘pattern-matching’ is used to compare the empirical patterns with those predicted from the conceptual model. If they coincide, this reinforces the internal validity, because it indicates that the research framework fits with the data. (3) External validity refers to the generalisation of the research. The results of the research relate in the first instance to concrete situations that are investigated, i.e. the zoning planning process in the six organisations. However, it is the research’s ambition to draw conclusions of a more general nature and in a wider context. This analytical generalisation is firstly sought by taking great care of the theoretical underpinnings of the research question, the conceptual model and the research framework. Second, generalisation is promoted by applying replication logic to multiple cases. Through investigating the link between the process configuration and spatial enablement in the different cases, research generalisation is part of the research framework. (4) Reliability refers to the ability to demonstrate that the research activities, such as the methods of data collection, are repeatable. The reliability of this research is strengthened by the principles of formalisation and explicitness. For each case, a case study protocol was compiled in which the working method to be used was explicitly laid out. Moreover, the final case report (Dessers et al., 2011a) constitutes an important element of this explicitness. In addition, besides the actual reporting, reliability is ensured by creating and keeping a formal compilation of the case study evidence. The research reports, transcripts, consulted documents, etc., are systematically kept together, and can be made available in order to further analyse the reliability of the research.

However, it has to be recognised that the research has a number of weaknesses, which are partly related to the decision to take a multidisciplinary approach. The conceptual research model and the research framework are primarily developed in light of that multidisciplinary approach. Research decisions that are optimal for such a multidisciplinary approach may be suboptimal for individual disciplinary aspects. Thus the selection of the cases and embedded cases might have looked different if the selection would only be based on the needs of a single discipline. A mono-disciplinary approach would strive for maximising variability for disciplinary variables, while minimising the variability for the unexamined variables (Miles and Huberman, 1994). Because in this research the variability for the different disciplinary aspects of the process configuration is maximised, assessing the impact of mono-disciplinary variables could be more difficult. But this is inevitable due to the decision to take a multidisciplinary, configurational approach in which the individual disciplinary factors are primarily regarded as an element of the configuration. Moreover, not all disciplinary factors are considered in equal depth, although extensive harmonisation between the relevant disciplines is achieved. Nevertheless, the researchers are convinced that the multidisciplinary strategy has clear added value. Addressing a multidisciplinary research question by means of a common conceptual model and research framework offers a perspective that is lacking in separate, mono-disciplinary approaches. Furthermore, the choice for multiple, parallel case studies implies also a limitation. An issue that is not addressed in this research methodology is the change over time of the process configurations. The study made a snapshot, while a more longitudinal approach, with repeated observations over a certain period, could provide insight into the ongoing evolutions of both process configurations and spatial enablement, and of the relation between them.

The findings of this study could have a number of implications for future practice. (1) The application of the proposed research methodology to other processes in other (international) contexts could provide more insight in the relation between process configuration and the spatial enablement of a process. The ready availability of the current research framework could make data collection and analysis more focused and structured than in the original research, since the methodology was gradually developed and fine-tuned in the course of the research itself. (2) Although the current conceptual model already contains a selection of factors from five different disciplines, the model could be enhanced by adding other disciplinary factors. (3) A more longitudinal approach could provide more insight in the dynamic aspects of process configurations and spatial enablement. (4) Finally, it may be fruitful to operationalise the concepts and their relations in a more quantitative research design, which could allow for a broader validation scope.

To conclude, the results of this investigation seem to confirm the applicability of the proposed multidisciplinary research framework for enhancing our understanding of the factors that may influence the role of spatial information in public sector processes. The findings seem to suggest that the realisation of SDI objectives related to the spatial enablement of public sector processes is strongly linked to the configuration of specific process characteristics. In order to further advance the role of SDI as an enabling platform, it may be advisable to take these process characteristics into account when developing future SDI initiatives and SDI measures.

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