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What can we learn from the INSPIRE Reporting Process?

Vancauwenberghe, Glenn; van Loenen, Bastiaan

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Governance and performance of open spatial data policies in Europe – What can we learn from the INSPIRE Reporting Process?

Glenn Vancauwenberghe (g.vancauwenberghe@tudelft.nl) - TU Delft

Bastiaan van Loenen (b.vanloenen@tudelft.nl) - TU Delft

1. Introduction

Many European countries are setting up initiatives and taking actions to make their data 'open', i.e. to make their data freely available for use and re-use without restrictions. The Digital Agenda for Europe, the first of seven flagships initiatives under Europe 2020, encourages governments to stimulate content markets by making public sector information available in a transparent and effective manner. It is hoped that the greater availability of interoperable public data will catalyse the secondary use of such data, leading to the growth of information industries and better government transparency. A large part of governmental data can be considered as spatial data, i.e. data that refer to a location on the earth. Typical examples of spatial data are topographical maps, address data, road data, and hydrographical data. Spatial data are becoming increasingly important in society, as most of the societal, environmental and economic challenges that governments, businesses and citizens are facing, require spatial understanding and insight.

While an important driving force for public organizations to open their data came from both the Digital Agenda of the European Commission and the revised PSI Directive, also the INSPIRE Directive establishing an infrastructure for Spatial Information in the European Community of 2007 had an important impact on the way public administrations organize the access to and sharing of their spatial data. The INSPIRE Directive requires public authorities to publish all spatial data related to the environment according to specific technical and non-technical specifications. For each spatial data set, a description of the data should be provided in the form of metadata, these metadata should be accessible through discovery services making it possible to search for spatial data sets, view services should be put in place making it possible to view the data sets and download services should be developed enabling to download the data – or parts of it - and access them directly. Data should be conform to the INSPIRE data specifications, while also the metadata and network services should be INSPIRE compliant. Moreover, public authorities should adopt measures for the sharing of spatial data sets and services between its public authorities enabling these public authorities to gain access to and exchange and use these spatial data sets and services.

INSPIRE aims to overcome the major barriers affecting the availability and accessibility of spatial data, through the development of a European spatial information infrastructure. This infrastructure will be based on the creation, operation and maintenance of the national spatial data infrastructures established and operated by the 28 Member States of the European Union, but also Switzerland, Norway and Iceland. With the entrance into force of the INSPIRE Directive, countries in Europe started or continued with the development of their national spatial data infrastructure according to the principles, rules and guidelines of INSPIRE. Such a spatial data infrastructure (SDI) consists of a

collection of technological and organizational components oriented towards facilitating and coordinating spatial data sharing. Among the key components of an SDI are the data, metadata, standards, access networks, policies, legal framework, funding and governance. Governance of the SDI is considered to be essential because many actors at different levels and in different sectors are involved in the development of this SDI's and relationships between these actors should be managed, in order to ensure all components are developed in a coordinated manner.

Public administrations in Europe and worldwide are aware of the need to promote, facilitate and coordinate the sharing of spatial data and have been working on the development of these spatial data infrastructure for many years. Most countries and public administrations however approach and implement their SDI in their own unique way. This especially applies to the governance instruments being utilized for managing the relationships and dependencies between all involved actors, units and organizations. Due to the lack of research on the governance of spatial data infrastructures, it still remains difficult to understand the impact of implemented governance instruments and governance models on the performance of the infrastructure. As a result, practitioners and policy makers remain uninformed and uncertain about the success and appropriateness of their governance model, and of their spatial data infrastructure in general.

The central research questions this paper aims to answer are: 1) which governance instruments are adopted for governing open spatial data infrastructures in Europe and 2) which tools and instruments do European members states use to monitor and evaluate the performance of their open spatial data policies? The paper will provide a first explorative analysis of how European member states are dealing with both the governance of their open spatial data infrastructures and the monitoring and assessing the performance of these infrastructures. The analysis will be mainly based on a desk analysis of information from the official INSPIRE reporting process. The INSPIRE Directive requires Member States to submit every three years a report on the status of development and implementation of their spatial data infrastructure and INSPIRE. The paper aims to assess the extent to which the information provided by the member states in the official INSPIRE Monitoring and Reporting process can be used to better understand the governance and monitoring practices and approaches of the member states. The results of the analysis presented in this paper will be a starting point for more in-depth analysis of the governance and performance of open spatial data policies through a series of case-studies.

2. 'Open' spatial data infrastructures

The original focus of SDI developments worldwide was on promoting and stimulating data sharing within the public sector. Also the primary aim of INSPIRE was to create a European Union (EU) spatial data infrastructure for enabling the sharing of environmental spatial information among public sector organizations, within and between member states and especially between member states and the European Commission. In many European countries, data sharing with organizations and individuals outside the public sector for a long time remained limited, as the mechanisms and instruments to support and facilitate this type of sharing were missing (Vancauwenberghe, Dessers, Crompvoets and Vandenbroucke 2014). This lack of mechanism and instruments to share spatial data to actors outside the public sector was an important barrier to a more effective and efficient use of spatial data throughout society (McDougall 2009).

However, even if the development of SDI was not primarily aimed at fulfilling the spatial information needs of citizens, businesses and other potential users outside the public sector, the implementation of different SDI components indirectly contributed to promoting and enabling the re-use of spatial data. For instance, also the INSPIRE Directive aimed to tackle many barriers to the - commercial – re-

use of data and services: a central access point is established where users can discover all available data and services of all member states and also view most of these data and services free of charge; download services for getting direct access to spatial dataset need to be put in place, and data providers need to provide information on the conditions applying to access to, and use of, spatial data sets and services and on the corresponding fees. Also the need to make data available harmonized to the INSPIRE specification enables the re-use of this data by other parties. Analysing the different components and requirements of INSPIRE, it can be concluded that the Directive makes an important contribution to promoting the re-use of spatial data, by enhancing the legal and physical attainability of the data but also the usability (Van Loenen & Grothe 2014).

In recent years, several countries and public administrations started to make a shift towards the establishment of an 'open' spatial data infrastructure, in which also businesses, citizens and non-governmental actors are considered as key stakeholders of the infrastructure. In many countries this is illustrated through the strong alignment between SDI/INSPIRE implementation and the national open data agenda and related initiatives. In European countries such as the United Kingdom, the Netherlands and Finland, the awareness that spatial data could also be of high value for non-governmental users and effort was needed to involve these stakeholders in the development of the SDI was present even before the national open data agenda was launched. In these countries, businesses, research and non-profit organizations but also citizens were given clear tasks and responsibilities in the collection, management and distribution of spatial data, these parties could provide input on the decisions and actions related to the SDI, and also received access to the data and services available in the SDI. This however brought many additional challenges related to the governance of the SDI and new and additional governance approaches and instruments had to be implemented.

3. Conceptual framework

3.1. SDI & Open Data Performance

Measuring and evaluating the performance of SDI's has always been a key issue in the research on and practice of SDI development. Much work on developing and applying frameworks and methods to monitor and measure the performance of SDIs has been done and several scientific papers have been published about this topic. Rodriguez Pabon (2005) developed a theoretical framework for the evaluation of SDI projects through the identification and description of common success criteria across different contextual backgrounds. Van Loenen addressed the assessment of spatial data infrastructures from an organizational perspective (Van Loenen, 2006; Kok & Van Loenen, 2005), focusing on organizational aspects such as vision, leadership, communication, self-organizing ability, awareness and financial sustainability. Crompvoets (2006) developed a methodology for measuring the access to and use of geoportals. The SDI readiness index developed by Delgado Fernandez et al (2005) expresses the capacity and willingness of countries to use SDIs, taking into account organizational, informational, human resources, technological and financial resources factors. Applying performance-based management to SDI assessment, Giff & Crompvoets (2009) proposed an approach for designing performance indicators for SDIs. Grus (2011) combined different approaches into one Multi-view SDI Assessment Framework. A summary and discussion of different academic approaches is provided by Crompvoets et al (2008) in their work on 'A multi-view framework to assess spatial data infrastructures' and Genovese et al (2009) in their classification of the literature on the socio-economic impact of Geographic Information.

Also public authorities themselves are actively engaged in monitoring and assessing the performance of their (open) spatial data initiatives and policies. Again, the European INSPIRE Directive can be seen as an important driver in the monitoring and evaluation activities of European countries, as it requires

member states to monitor and report on the implementation and use of their infrastructures for spatial information. While in certain member states monitoring the performance and impact of spatial data policies is only done in the context of the official INSPIRE monitoring and reporting process, some member states go further, and have developed and implemented a more detailed and systematic monitoring framework. Examples of interesting initiatives are the Cost-Benefit analyses of INSPIRE in the Netherlands (Ecorys & Grontmij, 2009), the assessment of the social benefits of INSPIRE in Sweden (Ryden, 2011), the Business case approach on INSPIRE in e-government in Denmark (Kornborg Mazzoli, 2013) and the Benefits Realisation Strategy of the UK Location Programme (Jones & Wilks, 2013). Another interesting line of SDI performance assessment activities was the programme launched by the Joint Research Centre of the European Commission, the overall technical coordinator of INSPIRE, to identify frameworks that could be used for assessing the impact of INSPIRE. Valuable work that has been done as part of this programme includes an analysis of the socio-economic impact of the SDI's of Catalonia (Garcia Almirall et al, 2008) and Lombardia (Craglia & Campagna, 2010), a study on the use of spatial data for the preparation of environmental reports in Europe (Craglia et al, 2010) and a case study on e-Cadastres to estimate the benefits of SDIs (Borzachiello & Craglia, 2013). Finally, also the economic benefits of spatial information in particular have been subject of many studies. An important EU-wide initiative was the smeSpire study on the geo-ICT sector in Europe, in which the market potential of INSPIRE for geo-ICT companies was investigated (Cipriano et al, 2013). Other interesting examples are the work done by GeoBusiness in the Netherlands (2012), ConsultingWhere (2013) in the United Kingdom and ACIL Tasman in Australia (ACIL Tasman, 2008).

3.2. Open Spatial Data Assessment Framework

When monitoring the performance of public sector activities, often a distinction is made between input (what is invested and undertaken), output (what is delivered), outcomes (what are immediate results) and impact (what are long-term benefits/changes) (Bouckaert & Halligan, 2008). A similar model introduced in the context of e-government was the e-government value chain (Heeks 2006), which makes a distinction between readiness, availability, uptake and impact, where readiness refers to the capacity of governments to develop and implement e-government services; availability refers to the online availability and accessibility of e-government services; uptake refers to the uptake of e-government services by citizens, businesses and administrations; and impact refers to the financial and non-financial benefits of using e-government services, both direct and indirect. Table 1 shows that the same logic can be applied to the development and implementation of (open) spatial data infrastructures as initiatives to increase the availability and accessibility of spatial data.

Readiness	Availability	Use	Benefits
Technological and non-technological SDI components	Availability and accessibility of spatial data and services	Use of spatial data and services by public administration, citizens and businesses	Financial and non-financial benefits of using spatial data and services

Table 1 Open Spatial Data Assessment Framework

In the open data community, the initiative was taken to create a 'Common Assessment Framework for Open Data' as an overarching framework for the study and assessment of open data (Caplan, Davies, Wadud, Verhulst, Alonso & Farhan 2014). The framework makes a distinction between four dimensions, which are strongly similar to the elements in the e-government value chain and the dimensions of the proposed Open Spatial Data Assessment Framework, and also follow a input-output-outcome-impact logic. The four dimensions in the 'Common Assessment Framework for

Open Data' are Context/Environment (i.e. the context within which open data is being provided), Data (i.e. the nature and quality of open datasets), Use (i.e. how is data being used and with what possible outcomes) and Impact (i.e. the benefits gained from using open data). For each of the four dimensions, a set of subcomponents and associated key questions are formulated, potential indicators are defined and existing projects and examples are listed. In that way, the Framework not only provides a categorization of the work done so far on describing, measuring and analysing open data policies, initiatives and practices, but also an introduction to and overview of remaining challenges in measuring open data.

3.3. Governance aspects of Readiness

The Readiness-dimension of the Open Spatial Data Assessment Framework deals with the different technological and non-technological components of an SDI. The implementation of each of these components is not an end in itself, but should lead to an increase availability of spatial data and services, a better use of these data and services and the realization of different types of benefits. In research and practice on SDI, many different categorizations and definitions of the components of an SDI can be found back. In a similar manner, also the open data literature contains many different categorizations and definitions of the key components of open data policies and infrastructures, or of the context/environment in which data are made open. The 'Common Assessment Framework for Open Data makes a distinction between legal and regulatory aspects, organizational aspects, political aspects and leadership, technical aspects, social aspects, and economic aspects.

The focus of this article is on governance, which can be considered as one of the key components in the development of an – open – spatial data infrastructure. Governance is defined as the adoption of structures, procedures and instruments for managing the relationships and dependencies between all involved actors, units and organizations. For the analysis of the governance of SDI and INSPIRE implementation, in this paper the approach introduced by Verhoest, Bouckaert and Peters (2007) for describing and analyzing trajectories of specialization and coordination in the public sector is followed. Verhoest et al (2007) focus on the instruments - and underlying mechanisms - that are adopted through time to enhance the alignment of tasks and efforts of organizations within the public sector, and made a classification of twelve coordination – or governance – instruments: strategic management, financial management, interorganizational culture and knowledge management, consultation or review systems, reshuffling of competences, reshuffling of lines of control, regulated markets, systems for information exchange, negotiation bodies and advisory bodies, entities for collective decision-making, common organizations and chain management structures. Crompvoets, Masser, Vancauwenberghe and Pauknerova (forthcoming) used this list as a starting point for the analysis of SDI governance practices, and identified 11 common practices of SDI/INSPIRE governance in European countries (see table 2). The aim of this article is to explore how different governance instruments are used in the context of an Open SDI, for managing the relationships and dependencies with actors and organizations outside the public sector.

Governance instruments	SDI Governance
1. **Strategic planning**	Design of SDI strategies and strategic plans
2. **Division (re-shuffling) of competences**	New tasks and obligations for data providers (decentralized model) and/or central coordinator
3. **Establishment of coordinating functions/entities**	Establishment of new organization (or new entities within existing organizations) responsible for SDI coordination
4. **Collective decision making**	Coordination structure in which central data providers are represented
5. **Establishment of partnerships**	Data sharing partnership among public sector organizations
6. **Information and knowledge sharing**	Communication channels and events towards the spatial data community within the public sector

7. Performance management	Monitoring and reporting on SDI/INSPIRE implementation
8. Regulated market	Framework agreement for sharing among public bodies
9. Funding	Revenues through the sale of data and services as key funding model
10. Legal framework	National SDI law (transposition of European INSPIRE Directive)

Table 2 SDI Governance instruments

4. Methodology

The central research questions this article aims to answer are: 1) which governance instruments are adopted for governing open spatial data infrastructures in Europe and 2) which tools and instruments do European members states use to monitor and evaluate the performance of their open spatial data? To answer these research questions, a document analysis was undertaken of the official country reports on the implementation and use of infrastructures for spatial information that have to be submitted by all EU member states every three years. The analysis focuses on the country reports of three countries and one region: the Netherlands, Slovenia, Luxembourg, and Flanders (Belgium). This section discusses the approach for and content of the country reports and briefly introduces the four spatial data infrastructures that will be analysed into detail.

4.1. The INSPIRE Monitoring and Reporting process

According to the INSPIRE Directive, EU Member States have to monitor the implementation and use of their infrastructures for spatial information and make the results of this monitoring accessible to the Commission and to the public on a permanent basis. Moreover, Member States should also report to the Commission on the coordination and the organization of quality assurance within their infrastructure, on the contribution of different partners to the functioning and coordination of the infrastructure , on the use of the infrastructure for spatial information, on data-sharing agreements and on the costs and benefits of implementing the INSPIRE. While monitoring information should be provided yearly, the reports on INSPIRE implementation should be created and submitted every three years. The content of the monitoring and reporting is defined into detail in the Commission Decision 2009/442/EC of 5 June 2009 on monitoring and reporting of INSPIRE.

Monitoring follows a quantitative approach and includes the establishment of the list of spatial data sets and services of the Member States. For each data set – and service – information should be provided on the existence of metadata, the conformity of metadata to the INSPIRE requirements, the geographical coverage (of data sets), the conformity of the data sets with the INSPIRE data specifications, the accessibility of the data through discovery services, view services and discovery services, the conformity of these services, and the use of these services. Based on the information for each data set and service, a set of indicators is calculated to evaluate the status of INSPIRE implementation. INSPIRE Reporting on the other hand follows a more qualitative approach, as Member States need to provide information on five areas: coordination and quality assurance, contribution of stakeholders to the functioning and coordination of the infrastructure, the use of the infrastructure for spatial information; data sharing arrangements between public authorities and cost and benefits aspects. Reporting started in 2010, with a first report on the status of the MS spatial data infrastructures and INSPIRE implementation in 2009. A second round of reporting was organized in 2013, providing information on the status and evolution of the infrastructure between 2010 and 2012. In May 2016, the third set of country reports were submitted by the member states, covering the period 2013-2015.

As it can be seen from the topics that have to be described in the country reports, these reports contain – or should contain – valuable and relevant information of the four components of the Open Spatial Data Assessment Framework we introduced in this paper. Table 3 shows how the different topics and sub-topics that have to be reported on can be linked to the four components of the Open

Spatial Data Assessment Framework (readiness, availability, use and benefits). For what concerns the readiness, the table focuses on the information relevant for describing the governance structures, instruments and processes of a member state.

Components of the Open Spatial Data Assessment Framework	Information provided in the INSPIRE country reports
Readiness Technological and non-technological SDI components (and governance instruments in particular)	▪ Role and responsibilities, organisation chart of the coordinating structure supporting the contact point of the Member State ▪ Relationships with third parties; ▪ Overview of the working practices and procedures of the coordinating body; ▪ Quality assurance procedures, including the maintenance of the infrastructure for spatial information ▪ Measures taken to improve the quality assurance of the infrastructure ▪ Description of the SDI and its vision/policy/strategy ▪ Overview of the various stakeholders contributing to the implementation of the infrastructure for spatial information ▪ Role of the various stakeholders in the development and maintenance of the infrastructure for spatial information ▪ Main measures taken to facilitate the sharing of spatial data sets and services between public authorities and a description of how sharing has improved as a result ▪ Description of how stakeholders cooperate ▪ Overview of data sharing arrangements that have been, or are being, created between public authorities inside the country ▪ Overview of data sharing arrangements that have been, or are being, created between public authorities and Community institutions and bodies ▪ List of barriers to the sharing of spatial data sets and services between public authorities and between public authorities and the Community institutions and bodies, as well as a description of the actions which are taken to overcome those barriers.
Availability Availability and accessibility of data and services	▪ Access to the services through the Inspire geo-portal ▪ *In Monitoring: list of data sets and services, existence of metadata conformity of metadata, geographical coverage of spatial data sets, conformity of spatial data sets, accessibility of metadata through discovery services, accessibility of spatial data sets through view and download services and conformity of network services*
Use Use of spatial data and services by public administration, citizens and businesses	▪ Use of the spatial data services of the infrastructure for spatial information ▪ Use of spatial data sets by public authorities, with particular attention to good examples in the field of environmental policy ▪ Evidence showing the use of the infrastructure for spatial information by the general public ▪ Examples of cross-border use and efforts made to improve cross-border consistency of spatial data sets
Benefits Financial and non-financial benefits of using spatial data and services	▪ Examples of the benefits observed, including examples of the positive effects on policy preparation, implementation, evaluation, examples of improved services to the citizen as well as examples of cross-border cooperation. ▪ Examples that have quantitative measures (e.g. increase in data use, more data sharing, savings in time and money, better policy outcomes, etc.).

Table 3 Link between the Open Spatial Data Assessment Framework and the INSPIRE Reporting

The aim of this paper is to explore to what extent the information as reported by the member states can be used to analyse the governance instruments used by European member states to open their spatial data infrastructure and the performance of this 'open' spatial data infrastructure.

4.2. Presentation of the four SDI's

Netherlands

In the Netherlands the political responsibility for implementing the national spatial data infrastructure but also INSPIRE lies with the Minister of Infrastructure and Environment. While it is the Ministry of Infrastructure and Environment that acts as the principal and budget holder of the SDI, the technical implementation of the infrastructure is in hands of Geonovum. The Ministry of Infrastructure and Environment also set up a steering committee, of which the main parties concerned in the SDI are members, and which is advised by a consultative group. Among the most important spatial data producers in the Netherlands are the Cadastre, the Ministry of Infrastructure and Environment, the Ministry of Economic Affairs, Agriculture, and Innovation, the Ministry of Defence, the Netherlands Meteorological Institute (KNMI), Statistics Netherlands (CBS), provincial governments, and district water boards. In the Netherlands, the development of the SDI is strongly related to the key registries of the national e-government policy and the national data facilities, that are based on national legal acts. The National GeoRegistry is the central access point to spatial data in the Netherlands. From the beginning, the Netherlands decided to follow a pragmatic approach for the implementation of Netherlands, doing nothing more than really is necessary for INSPIRE, and making maximum use of the existing key registers and the national facilities.

Slovenia

The legal framework for establishing and functioning of the spatial data infrastructure in Slovenia is determined by the Infrastructure for Spatial information (ISI) Act of 2010. Different stakeholders cooperate in the Republic of Slovenia in the development of the national spatial data infrastructure and the implementation of the INSPIRE Directive. These especially include data providers at the national level, such as the Ministry of the Environment and Spatial Planning, the Ministry of Infrastructure, different bodies affiliated to both Ministries, and also several other ministries. The Surveying and Mapping Authority, which is affiliated to the Ministry of the Environment and Spatial Planning, is key actor in the coordination and implementation of the infrastructure, as it is responsible for the tasks of the national INSPIRE contact point, but also for the development and management of the national geoportal and the national metadata information system. The Slovenian intersectoral INSPIRE project group was established as the strategic body authorized to steer the measures for sharing spatial datasets and services related to spatial data and implementing the INSPIRE Directive in practice. The project group offers guidance and assistance to individual public authorities managing spatial data and services, so that such data and services comply with the provisions of the ISI Act and the INSPIRE Directive.

Luxembourg

In the Grand-Duchy of Luxembourg an interdisciplinary and inter-ministerial task force was created to prepare and manage the development and implementation of the national spatial data infrastructure (LSDI). Leadership of this task force was in hands of the Administration of Cadastre and Topography (ACT), who was and still is responsible for most geographic data available in the Grand-Duchy. All other public bodies dealing with geodata in Luxembourg are closely linked to the 'LSDI' task force, and provide delegates to the Coordination Committee of the LSDI. The Coordination Committee acts as a steering committee of all the activities concerning the creation, updating, management and distribution of geographic data. From the start, the Committee followed a strongly collaborative and open approach, and until now still has not adopted an official set of rules. The Luxembourgish geoportal is considered to be the technical backbone of the Luxembourg's SDI. All the datasets and services that are relevant for INSPIRE can be discovered in this geoportal and its metadata catalogue, visualized in the map viewer of the geoportal, and accessed or downloaded through web services.

Flanders (Belgium)

Because of the federal structure of government in Belgium, four parties are responsible in Belgium for implementing the INSPIRE Directive: the federal government, the Walloon Region, the Flemish Region and the Brussels Capital Region. These four parties all have their own spatial data infrastructure, and are responsible for the coordination and implementation of INSPIRE within their own territory and jurisdiction. There currently is no overarching spatial data infrastructure in Belgium. In Flanders, the Dutch-speaking northern region of the federal state of Belgium, a framework for cooperation to development a government system for geographical information was developed in 1995. This framework, which current name is the partnership 'SDI-Flanders', aimed to optimize the production, the management, the exchange and the use of spatial data in Flanders. All public administrations in Flanders, including the departments of the Flemish government, the Flemish public agencies, the provincial authorities, and the municipalities, are considered to be partner of this partnership. All partners in the partnership are required by decree to contribute their geographical data to the GDI. Within the partnership 'SDI-Flanders', the regional Agency for Geographical Information Flanders (AGIV) is responsible for the operational coordination and exploitation of the Flemish SDI.

5. Governance of open spatial data infrastructures

In the country reports on the implementation and use of infrastructures for spatial information, EU Member States provide information on the governance structures, sharing agreements, use, costs and benefits of their national infrastructure for spatial information and of the implementation of the INSPIRE Directive in their country. Based on the reported information, this section aims to find an answer to the first research question, and provides an analysis of the use of different instruments to govern the relationships with non-government actors in the SDI. As reports have to be submitted every three years, starting from 2010, and now are available for three periods, the analysis also addresses changes in the adopted instruments between 2010 and 2016.

Netherlands

Since 2009, the Netherlands has taken several measures to make its spatial data policy and spatial data infrastructure more open. Already from the first stage of INSPIRE implementation (2009), actors outside the public sector were closely involved in decision making on the development and implementation of the SDI in the Netherlands. The central Steering Committee of the SDI in the Netherlands is advised by a Consultative Group, in which besides INSPIRE data providers also users, universities and the business community are represented. The Consultative Group is considered to be a main factor in the quality assurance procedure of the INSPIRE programme in the Netherlands, as the group examines the main results delivered by the INSPIRE programme and advises the steering committee on the implementation of the programme. The chair of the consultative group is member of the Steering Committee.

Besides in the coordination structure the ambition to develop an Open SDI is also reflected in the strategic planning and management of the implementation of the SDI. In 2008, the implementation approach and strategy for the development of the Dutch spatial data infrastructure was described in the GIDEON policy document. Besides several public authorities, also the research programme for geo-innovation in the Netherlands (Space for Geo-Information), the association for Geo-ICT companies (GeoBusiness Nederland), and several academic institutions contributed to the creation of this strategic document. The central objective laid down in the GIDEON document was to develop a spatial data infrastructure that all parties in society would use sustainably, successfully and intensively. Besides government organizations using the information provided by the infrastructure in their work processes, the infrastructure should also allow the public and businesses to retrieve and

use all relevant geo-information about any location and to add economic value to all relevant government-provided geo-information available for the purpose. In order to do this, close collaboration between all involved parties was considered to be essential. Also after the GIDEON document, actors and organizations outside public administration were closely involved in the preparation and adoption of strategic documents on the SDI and INSPIRE. In 2012, it was decided to concentrate more attention in the development of the SDI on the user side, and the focus was placed specifically on one Dutch domain, i.e. the Environment Act. Also the most recent policy document, the 'Partner in Geo' vision, is a shared vision of both the private, academic and public sector on the future of the geo-information domain in the Netherlands, in which open data is put forward as a key strategic priority.

Already in the first stage of INSPIRE implementation, the conclusion was drawn that important barriers to sharing and use of spatial data were related to the conditions for use, which often were not transparent, not harmonized and difficult to understand. Therefore, the Netherlands started with the development of the 'Geo Gedeeld' framework, which included a proposal to harmonize conditions for use. The framework was based on the principles of Creative Commons and was based on a set number of standard conditions for use with an individual icon, layperson's wording and a legally binding text. Each data owner had to specify which of the conditions for use (one or more) were applicable to his/her data or services. In the second phase of INSPIRE implementation, after 2010, the 'Geo Gedeeld' framework was actually implemented as the standard license framework for geodata in the Netherlands. In 2014 it was decided to bring the Dutch spatial data policy in line with international standards, and to apply where possible the Creative Commons framework. A "*Creative Commons, unless*" principle was introduced, which means governments now have to apply one of the Creative Commons licenses when making their data available, unless they want to impose specific conditions the Creative Commons framework does not cover. In that case, they have to apply the 'Geo Gedeeld' framework.

Already in 2011, the ambition was set in the Netherlands to make access to all government data by definition unconditional and free of charge, and the development of an open data policy was considered to be essential for achieving this ambition. The review of the Public Sector Information Directive and the work on an amendment to the Government Information Act was considered as an opportunity to incorporate the *'open, unless'* principle into legislation. But already in anticipation of this legislation, the Minister for Infrastructure and Environment declared in 2011 to open all government data coming under the Ministry of Infrastructure and Environment by 2015 at the latest. At the same time, the national 'Open Data Programme' was launched by the Minister for the Interior, as part of which the Dutch Open Data Portal (data.overheid.nl) was opened, providing access to a large number of open data sets, including the data sets from the National GeoRegistry.

Slovenia

In Slovenia, the implementation of a more open spatial data infrastructure and spatial data policy mainly took place in the third phase of INSPIRE implementation and reporting. In the first years of INSPIRE implementation, private partners were considered as a relevant actor in the SDI, but only in their role as contractors of technically demanding tasks in establishing and operating the Slovenian SDI. Businesses could play an important role in the standardization and harmonization of data during in data collection and maintenance processes. Good practices and experiences in other countries raised the awareness on the potential role of private companies as provider of value added services on top of the public sector data. However, to make this possible in Slovenia, the limited access to spatial data had to be re-examined and regulated, with the aim to provide also non-government actors access to the data they would like to use. The lack of a long-term and stable funding model however was an important barrier in opening spatial data to actors outside government. Therefore, the focus of the SDI in Slovenia for a long time remained on data sharing among public sector bodies, and only these public sector bodies were represented in the SDI governance structure. Such a

structure did not exist in the first phase of INSPIRE implementation, and was implemented after 2010 with the 'Intersectoral INSPIRE project group'. While in this intersectoral INSPIRE project group especially data providers were represented, recent discussions with different stakeholders made clear that the focus should be shifted towards the inclusion of stakeholders who are not responsible for managing and collecting spatial data. It was proposed to create a new or strongly adapted common platform in which also private sector representatives and representatives from research and education in the field of geo-informatics are closely involved in decision making.

Several important changes towards making the Slovenian SDI more open took place between 2013 and 2015. These changes were driven by or related to the legal framework, strategic planning, the establishment of coordination bodies and awareness raising. With regard to the legal framework, a new Act amending the original Infrastructure for Spatial Information (ISI) Act, which transposed the INSPIRE Directive into national legislation, was passed in 2015, on the basis of an EU Pilot enquiry procedure of the European Commission. To ensure the correct and complete transfer of the INSPIRE Directive several changes and supplements had to be made to original ISI Act. For instance, changes were needed to the ISA Act provisions on restrictions for public access to spatial data sets and networks services and on data and service sharing. In 2016, a Decree on the criteria and conditions for determining costs for the use of network services and for determining charges for spatial datasets and services sharing was passed. This decree regulates the preparation of a bill of costs regarding use and sharing of network services and spatial data. While in previous years data sharing between public authorities was organized through mutual agreements among data providers and data users, because of the changes in the legislation such agreements now no longer are needed. Another major development in the legal framework was the Amendment of the Public Information Access Act (ZDIJZ-E), which transposed the new Directive on the re-use of public sector information (2013/37/EU) into national legislation. As a result of the amendment, data gathered in the public administration during the execution of public tasks now have to be available for reuse without charging fees.

Already in 2009, the development and implementation of the Slovenian spatial data infrastructure was mentioned and included in several national strategic documents, such as the national e-Government strategy, Slovenia's Development strategy, and the strategy on e-Commerce in public administration bodies. In the third phase of INSPIRE implementation the activities to further develop and establish an SDI in Slovenia were embedded in a broader eSpatial strategy, which aims to improve processes in the field of spatial planning, construction and real estate management through reliable, interoperable and easily accessible spatial information. The eSpatial strategy itself was considered to be part of the broader e-Government strategy in Slovenia. In order to realize better alignment of spatial information activities and e-government activities in Slovenia, the proposal was launched to establish a Strategic board for geo-informatics which would operate as a part of the Strategic board for development of informatics and would be in charge of coordinating all strategic tasks in the development and management of the SDI in Slovenia. Another important evolution since 2013, was the increased effort and energy that has been invested in promotion and awareness raising activities on the implementation of INSPIRE in Slovenia. An example of such activities is the Slovene INSPIRE day, which brought together not only representatives from data providers but also from private firms and educational and research institutions.

Luxembourg

In the first years of INSPIRE implementation, public research centres and universities were considered as stakeholders of the SDI in Luxembourg, besides several public administrations. It was argued that these research centres and universities could produce and maintain possible interesting data that might become relevant for INSPIRE in the future. This means originally private companies and citizens were not seen as a relevant stakeholder. Only the use of public sector data by engineering firms and architects in the scope of their projects was considered as a potential situation in which private companies could take advantage of the SDI. In the second official INSPIRE report, private software

producers were added to the stakeholder list, although their precise role and how they would be involved in the SDI was not defined into detail. Until 2013, the SDI in Luxembourg mainly was about facilitating and coordinating the exchange of spatial data among public sector organizations, and only public sector organizations were involved in decision making processes on the SDI. This did not change in the third phase of INSPIRE implementation. A recent development relevant in the light of realizing a more open SDI was the establishment of a *working group on geodata policy,* which aimed to develop a government wide geodata policy. Main reason behind the establishment of this working group was the absence of a legal framework dealing with the (public) access and use of spatial data, while in reality public administrations were adopting several different technologies for making their data available. Also the PSI Directive, the transposition of this Directive into national legislation and the commitment of the national government to develop and implement an open data policy were important drivers behind the establishment of the working group on spatial data policy.

The Luxembourgish Law stipulated that spatial data can be shared free of charge between all the public authorities, which was done via a set of view and download services. Geodata were made available via spatial data services, but were only accessible from inside the official government network. Non-government actors could only view and query these data via viewer(s) on the national geoportal, downloading the data was not possible for them. An important change in opening the Luxembourg spatial data infrastructure took place recently, with the launch of the national *open data portal.* The Administration du Cadastre et de la Topographie (ACT) who is leading and coordinating the development of the SDI in Luxembourg, also played a key role in the development of the open data portal. For ACT, this was an important change in its data policy, as before the launch of the portal most of the data sets of the ACT had a restricted access policy and were not available free of charge. With the launch of the open data portal, several key data sets such as the cadastral map, topography, addresses were released as 'open and free services'. However, not all the data sets behind these services are free of charge. For instance, for getting access to data sets such as cadastral data and topographical data still certain fees have to be paid. Some data sets were made available as open data. These included old version of data sets and new data sets for which the price and use conditions are not determined by law, such as address data and street names. With the creation of a first list of data sets and services that could be considered as open and free data, the ACT aimed to stimulate other data providers to also open their data. It is expected that in the – near – future all data sets that can be accessed via existing geoportals will be available as open data.

An important barrier to opening spatial data in Luxembourg is the lack of an official government-wide license framework or model for the re-use of data. Each public data provider still uses its own terms and conditions for declaring their data to be open, and no commonly known national or international licenses or declarations are being used. The Luxembourg's Spatial Data Infrastructure seems to be heading towards the adoption of CCo as general "licence" for its geodata, for all datasets that are not explicitly put under other rules. However, this still needs to be decided and implemented in the near future, in the context of the working group on data policy.

Flanders (Belgium)

Although in the first years of INSPIRE implementation the SDI in Flanders mainly aimed to support governments in the execution of their public tasks and the commercial re-use of data was rather uncommon, from the beginning actors outside the public sector were considered and treated as important stakeholders of the SDI. This was especially reflected in the governance structure of the SDI, in which an advisory body was established composed of representatives from civil society, the private sector and the academic sector. This body, the GDI Council, gave strategic advice to the responsible Minister on issues related to the development of the Flemish spatial data infrastructure. While the GDI Council rather had an advisory role, decision making on the SDI mainly took place in the Steering Committee, in which experts from public authorities from the Flemish administration, the Flemish provinces and the Flemish towns and cities and municipalities are represented. One of

the tasks of the Steering Committee was to determine the conditions under which government data are made available to third parties, in consultation with the public data provider. Private companies were involved in the Flemish SDI in the first years of the development as data providers of data sets that were made available to all partners of the Flemish SDI. This was organized by the AGIV, the coordinating body of the Flemish SDI, who concluded agreements with third parties regarding the dissemination of the geographical data of third parties to Flemish public authorities.

Also in the second phase of INSPIRE implementation (2010-2012), public authorities were still seen as the main users of the data and services of the SDI. By means of electronic 'viewers' access for the public to the data in the SDI was realized. However, making the SDI more accessible for commercial reuse was considered as a policy priority for the next years. Awareness raising on the topics of open data and commercial reuse was considered to be essential, but an important development towards a more open SDI in Flanders was the creation of a license framework consisting of 5 licence models for the provision of open data by entities in Flanders. These included a Creative Commons Zero deed, a Free Open Data Licence, an Open Data Licence at a Fair Cost, a Free Open Data Licence for Non-Commercial Re-Use and Open Data Licence at a Fair Cost for Commercial Re-Use.

The most recent development in the SDI Flanders towards a more Open SDI is the establishment of the 'Information Flanders' agency, in which several departments and agencies dealing with information and information policies in Flanders are merged into one single agency. The aim of this agency is to support the Flemish government with its digitization policies, acquisition, management and use of information, along with the integration of e-Government services and management of public archives. Government information and e-Government services will be made available in user-friendly ways, and public administrations, companies, organisations and citizens will be supported in making use of this information.

6. Performance of open spatial data infrastructures

While the previous section focused on the governance of the SDI, and of the relationships with actors outside public administration in particular, this section provides an analysis of how European Member States monitor the performance of their spatial data infrastructure in the context of INSPIRE, in order to find an answer to the second research question. Again, the focus will be on the openness of the SDI towards non-government actors, i.e. the performance from the perspective of these actors. The analysis focuses of three main dimensions of open spatial data performance - availability of data to businesses and citizens, use of data by businesses and citizens and benefits achieved by or for businesses and citizens – and is based on the information as provided in the official country reports.

Netherlands

Availability

In the 2009 report and in the 2013 report submitted by the Netherlands it was argued that the general public mainly gets access to and makes use of the infrastructure for spatial information via applications on government websites. The 2009 report referred to the websites of municipalities as a good examples, as on these websites more and more use is being made of maps to display information. Also in the 2013 report several examples of websites using spatial data to publish and display information were given, such as the environmental atlas, housing information and land-use plans. The most recent INSPIRE report of 2016 contained a brief presentation and discussion of the environmental atlas, focusing on the information made available on this website, and the way the atlas has been developed. The 2016 report also introduces the Dutch Open Data Portal as an example of how the SDI is used by the general public. All spatial data sets that are included in the National

GeoRegistry and can be considered as open data, are automatically made available through the Dutch and European Open Data Portal. As a result, almost half of the open data in the Netherlands are spatial data.

Use

Figures on the use of spatial data in the Netherlands reported in the INSPIRE reports mainly include the number of users of the national discovery service containing the metadata of all data sets in the National GeoRegistry. In 2015, this services was used almost 6 million times, while around 24 million requests were made to the GeoRegistry itself. About the use of the other – view and download services – the 2009 report stated that there was no complete picture on the use of the network services, because the arrangements to measure this were not implemented (yet). In the 2013 report it was argued that such arrangements were implemented, but individually by each service provider, and only used by these service providers for their own internal work processes.

Benefits

In 2009, a cost benefit analysis was carried out of the implementation of INSPIRE in the Netherlands. In this analysis, a comparison was made of two alternative implementation models: a basic model, in which the impact of INSPIRE on organizations managing geo-information is kept minimal, and a collective model, in which all organizations managing geo-information in the Netherlands should make their data INSPIRE compliant. The analysis was based on the information supplied by various relevant parties (both data providers and users) from a number of (theoretical) use cases. The analysis revealed that the implementation of INSPIRE in accordance with the basic model would be more efficient than the collective model, because the costs incurred should be lower and more benefits will be generated. The cost-benefit analysis confirmed the choice made by the Netherlands to apply the basic model. In addition to the discussion of the cost-benefit analysis, the 2009 INSPIRE report discussed the strategic impact of INSPIRE, which also was considered to be great. The results of the cost-benefits were repeated and updated in the 2013 report, focusing on INSPIRE implementation between 2010 and 2012. The originally estimated costs for guidance and coordination of INSPIRE implementation in 2011 and 2012 in reality seemed to be higher than originally estimated (EUR 1 250 000 per year instead of EUR 700 000 per year). Although the benefits started to be reaped, it was mentioned that realizing these benefits was not fully under way, because only a few INSPIRE services were available at the time of the reporting. In 2015-2016, a new cost-benefit analysis of INSPIRE implementation in the Netherlands was carried out, since the original cost-benefit analysis was considered to be outdated. The updated cost-benefit analysis demonstrated that the costs of INSPIRE implementation were significantly higher than originally was estimated. Main reasons for this were the lack of experiences in implementing INSPIRE in 2009 and the complexity of INSPIRE. An important conclusion of the analysis was that quantifying the benefits of INSPIRE still remained to be difficult, although the strategic benefits of INSPIRE are clear, and even more tangible than originally expected. These strategic benefits include several benefits to citizens, businesses and society in general, such as the opportunity for businesses to develop value added services, the fact that citizens are better informed and the improved access to better and more up-to-date data and information.

Slovenia

Availability

In 2009, a central geoportal was not developed yet in Slovenia, and existing data sets and services were available to multiple online portals: besides the "Prostor" portal of the Surveying and Mapping Authority, and the geoportal of the Environmental Agency of the Republic of Slovenia, which both contained metadata of approximately 100 data sets, also several portals managed by private firms existed. The two government portals provided public access to several data sets, but little information

is provided in the country reports on the precise access and use conditions. A national INSPIRE geoportal was implemented in the second phase of the reporting in 2011. However, besides the central national portal managed by the Surveying and Mapping Authority of the Republic of Slovenia, many other geoportals still remained in place, providing access to many different national spatial data sets and individual web services. In 2015 a project was carried out to establish an INSPIRE compliant network of services, including discovery, view and download services, but none of the services was yet accessible to the public at the time of the reporting.

Use

According to INSPIRE reports, the " *general public in Slovenia already uses the existing elements of the infrastructure for spatial information under the conditions defined by the Act on the Access to Information of Public Character and the Personal Data Protection Act*". Besides a statement on the fact that "particularly the services of data searching, accessing and downloading are available to the users" (in the reports of 2010 and 2013) and "that users can mainly access discovery, view and download services" (in the report of 2016), no information is given on what data are used by whom. The 2013 report contained a few figures on the total number of users: the website of the Surveying and Mapping Authority of the Republic of Slovenia had an average of almost 100,000,000 requests per year, while the Slovenian Environment Agency recorded almost 8000 hits per month at their geoportal. Similar numbers were reported in the latest INSPIRE report.

Benefits

Key message in the information provided on the benefits of SDI/INSPIRE in Slovenia in the first official report was that at that time the advantages and benefits could only be assessed on the basis of single, ad hoc experiences, because monitoring the benefits was not done in a systematical manner. The same message was repeated in the 2013 report, although this second report contained some general descriptions of first benefits that have been experienced. Among these were reductions in the number of request for data, reduced burden on internal resources, wider accessibility of data and others. In the latest report, it was concluded that "*a more financial estimate of the benefits of the establishment of an infrastructure for spatial information in the Republic of Slovenia is not possible*". In addition to this, the report included some references to some existing national and international benefit assessment studies, of which most were ex ante evaluations.

Luxembourg

Availability

For a long time, users outside the public sector could only view government spatial data through the national geoportal and its map viewer. The map viewer was aimed to the general public and was developed to democratize the access to the available data. In the second stage, several other geoportals and viewers have been made available, focusing on data – and users – in a certain thematic area (e.g. agriculture, tourism, traffic, etc.) or geographic area (e.g. municipal geoportals). The publication of data on a public or semi-public geoportal was considered as an essential step towards the future re-use of data, as awareness and knowledge of existing data sets often triggers the re-use. Another important evolution in the second stage is the re-use of the API of the national geoportal in several other applications and websites. However, the re-use of this API was hindered because of the lack of awareness on the existence of this API as well as the complex and unclear access and use restrictions. Although the first two INSPIRE reports contained information on which data providers are responsible for which data sets and which data are accessible through services, no information was provided on the data that can be viewed through the map viewer. In the latest report, a list of datasets recently added to the portal was provided. These data include a new background map with partial coverage of the territory of the neighbouring countries (50 km), data on agriculture use

parcels, a detailed geological raster map, noise emission maps, mobility data ,land reorganization zones, land use and sector plans, and several other data sets. The most recent development is the launch of a first version of the national open data portal, with the general aim to centrally present Luxembourg's official data (and geodata). The Administration of Cadastre and Topography (ACT), which is the leading organization in SDI/INSPIRE implementation in Luxembourg, also was a key actor in the development project of the open data portal. Most of the ACT's central datasets, which previously had a restricted access policies and were sold by the ACT, like cadastral map, topography, addresses recently have been released and announced as "open and free web services".

Use

The information reported on the use of the SDI and data originally was limited to information on the use of the national public viewer (http://map.geoportal.lu). The use of the portal is monitored through analysis of the weblogs. The original report stated that the viewer became more and more popular and the number of users per day was constantly growing. Hard numbers on the use of the geoportal are provided in the 2013 report, which stated that the "*general public shows unexpected high interest in the geoportal*". On normal working days, about 6000 distinct users make use of one of the different mapping portals or API-powered applications and website, while on some days, the figure can rise up to 25.000 single users. Monthly around 17.000 maps are printed with the mapping portals' printing function. The same numbers are repeated in the latest 2016 report on the period '2013-2015'. In both reports, it was also stated that "*private firms have discovered the free INSPIRE web services, and among those the orthophotos are the most popular*".

Benefits

In the first report (2009), it was only mentioned that previous chapters of the report contained several examples of success stories due to the implementation of the recently implemented Luxembourg SDI and geoportal. The second report (2013) focused on the national geoportal for describing the benefits, which according to the report "*brought great benefits to Luxembourg's public sector bodies, private firms and the citizen in general*". In addition to this statement, a short presentation of some interesting projects was given, mainly focusing on projects in which public bodies, private firms and citizens collaborated on the use and exchange of spatial data. However, none of the INSPIRE reports for Luxembourg goes further than mentioning increases in the use of spatial data by citizens or companies.

Flanders (Belgium)

Availability

Until 2009, the SDI in Flanders was mainly focused on making spatial data available to support the execution of public tasks. Public administrations in Flanders were considered to be the most important users of the data delivered by the SDI. The central discovery service of the Flemish SDI contained 327 metadata records for data sets and service in 2009. These also include data sets outside the scope of INSPIRE. Approximately 50 data sets are falling under the scope of INSPIRE. For most data and services, commercial re-use of data originally was not – automatically – allowed by the data provider, and use of the data was restricted to consulting the data through online viewers. During the second phase of INSPIRE implementation, Flanders started to closely monitor the availability, accessibility and re-usability of its spatial data sets, as an extension to the official INSPIRE monitoring. Also information on the charges asked for data and the used license model was collected for all data sets. By the end of the second reporting phase, 73% of the INSPIRE data sets were accessible to the public, which meant they could be viewed and downloaded. It was expected that by the end of 2013, 87% of the INSPIRE data sets would be accessible to the public. Commercial reuse was authorized for about 33% of the data sets. According to the latest information on the status of the SDI in Flanders,

more than 80% of the approximately 140 identified data sets currently are made reusable, mainly through an Free and Open Data-license. During the second phase, access to INSPIRE data was also made possible through seven INSPIRE-compatible GDI view services that are made available not only to the SDI partners but also to third parties. The data sets viewable through these services were data on administrative units, addresses, protected sites, land use, elevation and orthophotos. These view services could be access free of charge for personal, non-commercial and test use. For the use of the view services for commercial purposes, an application had to be made to the administrator of the view service, and depending on the intended commercial use, additional conditions of use and/or cost of provision may be imposed.

Use

As the use of Flemish geographical information by the general public occurred mainly via viewers or geo-services' at the geoportal, the use of the SDI and its data and services by the general public was monitored through the number of visitors of the geoportal and of the different 'viewers' on the portal. In 2009 the average monthly number of visitors of the portal was around 250.000. In 2012, there were 2 151 267 hits via a Geo-service, compared to 2 356 108 the year before. Topics relating to spatial planning or the sale of real estate (regional plans, spatial implementation plans and pre-emptive rights), data sets of Databank Underground Flanders and water issues (flood maps and water evaluation) are often consulted. The aerial photos and the street guide are also frequently examined. The latest INSPIRE report only provides general figures for the use of Geopunt, the newly developed geoportal. A clear increase of usage has been observed, with nearly 600.000 unique users/year and more than 3 500 000 page views/year for 2015.

Benefits

Originally, the benefits of the Flemish SDI as reported in the official INSPIRE report were fully focused on benefits to public administration, and only included a general statement that through the compulsory sharing and joint purchasing of data, it has been possible to achieve considerable savings for the public authorities concerned. In the report on the period 2010-2012, a statement was added on the impact of the extended and facilitated access and use of the data for public authorities, citizens, businesses and organisations. Because of the further encouragement of the reuse of the data within GDI Flanders, businesses could use a large number of data sets to create innovative products and services. The report also contained one example of benefits provided by the SDI to the general public. The online availability of network data and timetables of the public transport companies was presented as an example of how citizens could benefit from the availability of spatial data. However, calculating the benefits deriving from INSPIRE in more concrete terms, still was considered to be difficult or even impossible. The same conclusion was repeated in the latest report, which means that hardly no information of the benefits of sharing spatial data to citizens and business is available in the reports on Flanders.

7. Discussion and conclusion

The aim of this paper was to analyse how public administrations in Europe are dealing with the governance and performance of their spatial data infrastructures. The focus of the paper was on the 'openness' of these spatial data infrastructures, i.e. the extent to which non-government actors are involved in the development and implementation of the policies and infrastructures and the extent to which they have access to and could re-use governmental spatial data. Three European countries (Netherlands, Luxembourg and Slovenia) and one region (Flanders) were included in the analysis, for which the official INSPIRE country reports countries were considered as the primary source of information. In this section, we briefly discuss some of the main findings and conclusions of our analysis.

With regard to the governance of open spatial data infrastructures, the analysis revealed some important differences in the approach adopted and instruments used to govern the relationships with non-government actors in developing and implementing an SDI. While in the Netherlands and Flanders actors from outside the public sector such as private firms, research institutions but also citizens were seen as important stakeholders already from the start of SDI/INSPIRE implementation, in Slovenia and Luxembourg the focus for a long time mainly or even solely was on public sector bodies, and non-government actors were only recently recognized as relevant actors in the SDI. This differences is especially reflected in the coordination structures of the SDI's. A quite similar coordination structure was implemented in the Netherlands and Flanders, in which private companies and other actors outside the public sector were involved in decision making on the SDI through their representation in a consultative body of the SDI: the Consultative Group in the Netherlands and the SDI Council in Flanders already exist for many years, while Luxembourg and Slovenia only recently started to consider a more open coordination and decision making structure. An important similarity between all four cases, especially in the first phase of implementing INSPIRE, was the creation of several geoportals and thematic viewers to provide citizens and other stakeholders access to certain – thematic – data sets. However, with regard to the actual re-use of data, for commercial or non-commercial purposes, and the existence of a government-wide license framework or standard licenses, differences between the four cases were more pronounced, with the Netherlands being the leading country in the development of such a common license framework, followed by Flanders a few years later and Luxembourg and Slovenia where first steps towards the development of such a framework still need to be taken. Another governance instrument that has been successfully employed in the Netherlands is the creation and adoption of strategic plans and vision documents on the spatial data infrastructure. Both the content of these plans and the way in which they are developed could contribute to the realization of a more open spatial data infrastructure. Not only should actors not belonging to the public sector be closely involved in the preparation of the documents, the documents themselves should also address the relevance of the spatial data infrastructures to citizens, businesses and society in general, and should provide guidance on how these non-government actors could contribute to the development of these infrastructures.

As a conclusion of our analysis of the governance of 'open' spatial data infrastructures, it can be argued that several member states in Europe have implemented new governance instruments or have modified existing governance instruments to make their spatial data infrastructure more open. Table 4 provides an overview of the most common governance instruments used in the implementation of SDI's in Europe, and the way they have been modified or extended with new instruments for making the SDI more open.

While most country reports contain some relevant and valuable information on governance structures and arrangements in the SDI, the countries seem to struggle with reporting on the performance of their spatial data infrastructure in terms of availability of data and services, use of these data and services and benefits of the SDI. This not only applies to the availability to, use by and benefits for citizens, businesses and other types of non-government actors, but to the availability, use and benefits in general. For what concerns the availability of data, it can be argued that relevant information on the status of availability of data and services is provided in the yearly monitoring sheets member states have to submit. Discussing the content of these sheets and the approach followed for completing them in the country reports contributes to a better understanding of the extent to which spatial data and services are available and accessible in a certain country. However, the information as directly reported in the monitoring sheets does not include information on the conditions and limitations applying to access and use of the data and services, and is not suitable for assessing the openness of the infrastructure. As a good example, Flanders started to add information on the accessibility, re-usability, charges and applicable license for each data set to the original INSPIRE monitoring sheet, which leads to a more complete and better overview of the availability of spatial data and services. For what concerns information on and measurements of the use and

benefits of spatial data and the spatial data infrastructure, the quality and usability of the reported information and figures is rather low, which makes it difficult to assess the both aspects of the performance of the spatial data infrastructure of a certain country and to make compare the performance of multiple countries. Probably the most valuable initiative in the countries and region included in the analysis, is the cost-benefit analysis made – and repeated – in the Netherlands.

Governance instruments	'Open' SDI Governance
1. Strategic planning	Joint development of strategies by government, private sector and other stakeholders and strong focus of these strategies on the relevance and benefits of spatial data and spatial data infrastructures to actors outside the public sector
2. Division (re-shuffling) of competences	Allocation of key tasks and responsibilities in SDI development to actors outside the public sector: data production and maintenance, but also data use and creation of added value services.
3. Establishment of coordinating functions/entities	Establishment of coordinating bodies or entities focusing on 'information' policy, or strong collaboration between bodies/entities responsible for geo-information and those responsible for information in general.
4. Collective decision making	Involvement of non-government actors in decision making, via advisory bodies and/or participation in working groups
5. Establishment of partnerships	Creation of data sharing partners among different types of organizations, also including businesses and other non-governmental organizations.
6. Information and knowledge sharing	Communication and awareness raising activities focusing on the re-use of data, also aimed at potential users of spatial data, including actors outside public administration
7. Performance management	Collection and analysis of information on the availability of data and services to businesses and citizens, on the use of these data and services by citizens and businesses and on the benefits realized by businesses and citizens
8. Regulated market	Government-wide license framework and standard license models for access and re-use by businesses and citizens, also for commercial purposes
9. Funding	Implementation of funding models not dependent on revenues from the sale of data or services.
10. Legal framework	Requirement to open – spatial - data by default incorporate into legislation ("comply or explain")

Table 4 Governance instruments Open SDI Governance (based on Crompvoets et al, forthcoming).

The – explorative – analysis presented in this paper especially had an important methodological objective, as the aim was to evaluate the usefulness and limitations of the information provided in the official country reports for analysing the spatial data infrastructures and policies of European member states. The country reports were considered as a valuable source of empirical data because of their completeness, correctness and comparability (over time and between MS). The analysis undertaken in the context of this paper revealed some serious limitations related to each of these expected strengths of the reporting process. With regard to the completeness of the reports, our knowledge of and experiences with the development and implementation of the SDI in some of the countries/regions in the analysis (e.g. Flanders and the Netherlands) made it clear that some important developments and activities have not been described in the reports. Although the EC aimed to support and facilitate the reporting process by including a set of sub-topics and questions for each of the topics that have to be reported on, in many cases the member state(s) did not report all the requested information. An important challenge for using the country reports for research is about how to deal with missing or incomplete information. The comparison of the reports of the different countries also revealed significant differences in the quality of the reported information. In some cases, even inconsistencies could be detected in the information reported within the same report. The differences in the level of completeness and correctness of the reports, also had an impact on the comparability of the reports. As a result, it can be concluded that the country reports are a valuable

source of information for detecting and describing main trends and evolutions in the spatial data policies of EU member states, and to reveal some general differences in the way these member states are giving shape to their spatial data policy. Based on our experiences, we would however recommend to consider the country reports only as a starting point for the analysis, that should be extended and verified with data from other sources, such as the INSPIRE Monitoring sheets, documents and laws to which reference is made in the country reports, analysis of the European and national geoportal, and interviews with key stakeholders.

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