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Governance of open spatial data infrastructures in Europe

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Introduction

Since the 1990s, public administrations in Europe and worldwide have invested considerable resources in the development of infrastructures for promoting, facilitating and coordinating the exchange and sharing of geographic data (Dessers et al. 2011). A crucial driver in the development and implementation of these spatial data infrastructures (SDIs) in Europe was the 2007 INSPIRE Directive establishing an Infrastructure for Spatial Information in the European Community (European Commission 2007). The INSPIRE Directive aims to overcome the major barriers affecting the availability and accessibility of geographic data through the development of a European spatial information infrastructure, based on the creation, operation and maintenance of the national spatial data infrastructures in Europe. While the original focus of most of these spatial data infrastructures was on promoting and stimulating data sharing within the public sector, in recent years several countries and public administrations started to make a shift towards the establishment of a more 'open' spatial data infrastructure, in which also businesses, citizens and non-governmental actors are considered as key stakeholders and beneficiaries of the infrastructure.

The launch of national open data agendas and the implementation of related initiatives in several European countries was an important driving force in the development of these open SDIs. At the same time, they also brought a need for alignment between national open data and SDI policies. The move towards more open spatial data infrastructures also created additional challenges related to the governance of the SDI, as new and additional governance approaches and instruments had to be implemented. In order to engage different stakeholder groups, including data users and producers outside the public sector, and take

into account their needs and requirements, the scope of traditional governance structures, mechanisms and processes had to be expanded.

The central research question this chapter aims to answer is: Which governance instruments are adopted for governing open spatial data infrastructures in Europe? The chapter provides an analysis of how several European member states have been dealing with the governance of their open spatial data infrastructures since the adoption of the INSPIRE Directive in 2007. In the next section of this chapter, a brief introduction is provided to the concepts of open spatial data infrastructures and governance of these infrastructures. The third section describes the official INSPIRE reporting process and introduces the four spatial data infrastructures that will be analysed in this chapter. In the fourth section, the analysis is presented of how different governance instruments are introduced and implemented for the governance of these open spatial data infrastructures. The chapter ends with a discussion of the main findings in the fifth section and some conclusions and recommendations for further research in the sixth and final section.

Towards open spatial data infrastructures

Since President Obama's Memorandum on Transparency and Open Government announcing the creation of a transparent and collaborative government (Obama 2009), the concepts of open government and open data have attracted considerable attention from researchers, practitioners and decision makers. Open government data became a very popular topic in many parts of the world, including Europe, Australia, New Zealand and Asia (Wirtz & Birkmeyer 2015). In Europe, the Digital Agenda for Europe (European Commission 2010) and the revised Public Sector Information (PSI) Directive (European Commission 2013) encourage governments to stimulate content markets by making public sector information available in a non-discriminatory, transparent and effective manner, minimising barriers to reuse public sector information. 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 greater government transparency. A large part of government data can be considered as geographic or spatial data, i.e. data that refer to a location on the earth (Van Loenen 2006). Typical examples of spatial data are topographical maps, address data, road data and hydrographical data (Groot & McLaughlin 2000, Nedovic-Budic et al. 2011). These and other types of 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 (see Janssen 2011). It has been claimed that the economic value of billions of Euros will be created by the reuse of open government spatial data alone (Pira International et al. 2000, Dekkers et al. 2006, Forneveld 2009, Vickery 2011). Therefore, several types of spatial data were top-listed by the European Commission and the G8 for

release as open government data due to the high demand from re-users (Cabinet Office 2013, European Commission 2014). It is not surprising that calls for free access to spatial data played a particularly important role in the formation of a number of open data initiatives, including the UK (see Saxby 2011). Access to these high-value spatial datasets is, until very recently, primarily provided through national spatial data infrastructures.

In the past 20 years, public authorities in all parts of the world have invested considerable resources in the development of spatial data infrastructures. A spatial data infrastructure (SDI) can be defined as a collection of technological and organisational components oriented towards facilitating and coordinating spatial data sharing (Vancauwenberghe et al. 2014). Among the key components of an SDI are the data, metadata, standards, access networks, policies, legal framework, funding and governance (GSDI 2012, McLaughlin & Nichols 1994). The original focus of SDI developments worldwide was on promoting and stimulating data sharing within the public sector. Governments were the central actors in the development and implementation of spatial data infrastructure, since they are the major producers and users of spatial information (Janssen 2010). Data sharing with organisations 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 et al. 2014).

Several authors have suggested and explored the introduction of a new generation of more user-driven spatial data infrastructures and the need to redefine or expand the SDI concept (e.g. Van Loenen 2006, Masser 2009, Budhathoki et al. 2008, Hendriks et al. 2012, Coleman et al. 2016). Some authors considered the involvement and engagement of other stakeholders such as private companies, non-profit organisations, research institutions and also citizens to be essential to the realisation of a successful spatial data infrastructure (McLaughlin & Nichols 1994, Wehn de Montalvo 2001, Van Loenen 2006), while others argued for combining open data and SDI principles to optimise public sector information reuse (Van Loenen & Grothe 2014). The concept of open spatial data infrastructures expresses the need to open existing spatial data infrastructures to non-government actors. To begin with, open spatial data infrastructures involve the application of the principles of open data to spatial data, and making available spatial data for free to all potential users. These spatial data should also be license-free, machine processable and released in timely manner to the widest range of users in an open format (OpenGovData 2016). In addition to opening up spatial datasets to businesses, citizens and other users, open spatial data infrastructures also include the provision of different types of spatially enabled e-services to these citizens and businesses (Latre et al. 2013). The provision of data and services to non-government actors can be seen as opening the main outputs of the infrastructure to other parties. Another way of opening the infrastructure is by allowing other stakeholders to contribute to and participate in building the infrastructure. This means also businesses, research

institutions, citizens and other stakeholders should be able to add their own data and components to the infrastructure. The contribution of non-government actors to the development and implementation should go further than the traditional contribution, i.e. working as contractors for public administrations and providing services to these administrations (Vancauwenberghe et al. 2014). In other words, open spatial data infrastructures require a redistribution of data production activities among different types of organisations and users (Budhathoki et al. 2008). Open spatial data infrastructures can only be realised by putting in place processes, methods and tools that stimulate and enable non-government actors to add their own datasets and other components to the infrastructure. Ideally such an open SDI is embedded in the general data infrastructure of a country (cf. Gray & Davies 2015, Kitchin 2014).

Governance of open spatial data infrastructures

A key challenge in the establishment of open spatial data infrastructures is the governance of the infrastructure. Governance of SDIs is essential to the implementation of different SDI components in a coordinated and consistent manner (Craglia & Johnston 2004). The implementation of an open SDI is not only about opening spatial data, but also about organising and governing the infrastructure in an open manner, and considering non-government actors as important stakeholders. In order to take into account the needs and requirements of different stakeholder groups, data users and producers outside the public sector should also be involved in the governance of the SDI (De Kleijn et al. 2014). The governance of spatial data infrastructures deals with the adoption of structures, procedures and instruments for managing the relationships and dependencies between all involved actors, units and organisations. The central challenge of governance is reconciling collective and individual needs and interests of different stakeholders in order to achieve common goals (Box 2013). Governance of open data infrastructures requires expanding the scope of stakeholders to include the private sector, research bodies and other actors outside the public sector, to actively promote bottom-up and participative processes and to find the appropriate mechanisms and instruments to enabled the participation of these non-government actors (Georgiadou et al. 2005).

In open government and open data research and practice the importance of appropriate governance structures, mechanisms and processes is widely recognised (e.g. Lee & Kwak 2012, Martin et al. 2013, Jetzek 2016). Martin et al. (2013) identified governance as one of the seven risk areas in the development of open data initiatives. Particular risks related to the governance are inconsistencies in public policies, a lack of dialogue between producers and users, fragmentation between different administrative levels and the reluctance of civil servants. In their development of an Open Government Maturity Model, Lee and Kwak (2012) argue that appropriate governance structures are essential for governments

aiming to reach the highest level of open government. In her in-depth analysis of the Basic Data Programme in Denmark, Jetzek (2016) identified four governance tensions in the implementation of an open data infrastructure and four governance strategies that were used in Denmark to address these challenges. In several open data assessment frameworks and initiatives, governance is considered as a key element for determining the readiness of the infrastructure (e.g. World Bank Group 2015, Ubaldi 2013). However, despite the recognition of governance as a key component in the development of open data policies, so far little is known about the governance of open data and the different governance models used for open data policies (Lämmerhirt 2017).

Governance of public authorities and policies is one of the key topics in public administration research and practice, and several methods and approaches have been used for analysing governance in the public sector (Lynn et al. 2000, Bevir et al. 2003, Andresani & Ferlie 2006). For the analysis of the governance of open spatial data infrastructures, in this chapter the approach introduced by Verhoest et al. (2007) for describing and analysing trajectories of specialisation and coordination in the public sector is followed. Verhoest et al. (2007) focus on the instruments – and underlying mechanisms – that are adopted over time to enhance the alignment of tasks and efforts of organisations within the public sector. A classification is made of both management and structural instruments for coordinating and governing the relationships between public bodies. Management instruments include strategic planning and evaluation, financial management, culture and knowledge management and mandated consultation or review systems. Structural instruments are: reshuffling of competences and/or lines of control; establishment of coordinating functions or entities; regulated markets; systems for information exchange; negotiation bodies and advisory bodies; entities for collective decision-making; common organisations; and chain management structures. The aim of this chapter is to explore how these and other governance instruments are used for managing the relationships and dependencies with actors and organisations outside the public sector with the aim of realising a more open spatial data infrastructure.

Methodology and selected cases

The central research question this article aims to answer is: Which governance instruments are adopted for the governance of open spatial data infrastructures in Europe? To answer this research question, an explorative analysis is made of the development and implementation of spatial data infrastructures in three European countries and one region: The Netherlands, Slovenia, Luxembourg, and Flanders (Belgium). The study is based on a document analysis of relevant publicly available documents on the development and implementation of the national spatial data infrastructure and the implementation of INSPIRE in each of these four cases.

Document analysis

Key documents in the analysis are the official reports on the implementation and use of infrastructures for spatial information that have to be submitted by all EU member states every three years. According to the INSPIRE Directive, EU member states have to monitor and report on the implementation and use of their infrastructures for spatial information. The content of the monitoring and reporting is defined in detail in Commission Decision 2009/442/EC of 5 June 2009 on monitoring and reporting of INSPIRE. While monitoring follows a quantitative approach and includes the establishment of the list of spatial datasets and services of the member states, INSPIRE Reporting 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 benefit aspects. The country reports contain information on many different aspects of the governance approach implemented in the different countries, and different types of governance instruments that can be used to govern the infrastructure.

Reporting started in 2010, with a first set of reports on the status of the MS spatial data infrastructures and INSPIRE implementation in 2009. A second round of reporting was coordinated in 2013, providing information on the status and evolution of the infrastructure between 2010 and 2012. In May 2016, a third set of country reports was submitted by the member states, covering the period 2013 to 2015. As reports now are available for three periods, the analysis also addresses changes in the adopted instruments between 2009 and 2015. In addition to these official country reports, other policy documents were analysed, including implementation strategies, legislation and other official reports. Also, information, results and findings from other studies on SDIs in Europe and the national SDIs of the Netherlands, Flanders, Luxembourg and Slovenia were included in the analysis. Examples of these are the INSPIRE/ SDI State of Play Study (KU Leuven/SADL 2011a, 2011b, 2011c) the SmeSpire study on the involvement of the private sector in the implementation of INSPIRE (Vancauwenberghe 2013) and the UN-GGIM Country profiles (UN-GGIM 2016).

An important reason for selecting the four cases was the availability of information on the most recent SDI developments. While the first two editions of all official INSPIRE country reports have been translated into English, only four countries decided to submit the final version of the report in English: Belgium, Slovenia, Luxembourg and the United Kingdom. Since the latest UK report was rather concise and did not contain information on all the relevant topics, it was decided not to include the United Kingdom in the analysis. In Belgium, its regions are responsible for the implementation of the INSPIRE

Directive, and currently no overarching national spatial data infrastructure is in place. The decision was made to include only the regional SDI of Flanders, which can be seen as one of the most advanced regional SDIs. Besides Flanders, Slovenia and Luxembourg, the Netherlands was added as a fourth case, since the 2015 INSPIRE report and other reports were available in the mother tongue of the researchers.

Selected cases

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 delegated to Geonovum. The Ministry of Infrastructure and Environment also set up an INSPIRE 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; district water authorities; and municipalities. In 2011, the Ministry of Infrastructure and Environment adopted an open data policy for the entire ministry, and by 2015 all data of the ministry and its departments had to be made open (Netherlands Ministry of Infrastructure and Environment 2012). The ministry responsible for open data and access to public sector information, however, is the Ministry of the Interior and Kingdom Relations. In 2013, this ministry presented a vision and associated plan for action for open government in the Netherlands (Kabinet 2013a, Kabinet 2013b), followed by a national open data agenda (Kabinet 2015). From 2013 to 2016 the Ministry of Economic Affairs established an open data breakthrough team composed of representatives of the public sector, private sector and academia. This team lobbied for open data, investigated barriers in PSI reuse and organised open data innovation rallies to bridge open data supply and reuse. While the National GeoRegistry has been the central access point to spatial data in the Netherlands since 2009, open spatial data from the National GeoRegistry are harvested by the Dutch Open Data Portal, which was established in 2011.

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 a 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 authorised to steer the measures for sharing spatial datasets and services related to these 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. While the development of the national SDI was originally included in the National eGovernment Strategy, a specific SDI strategy was drafted for the period 2016–2020. However, integration with other relevant policies and strategies was still considered to be essential.

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 the hands of the Administration of Cadastre and Topography (ACT), who was and still is responsible for most spatial data available in the Grand-Duchy. All other public bodies dealing with spatial data 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 spatial 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 Luxembourg's SDI. All the datasets and services that are relevant for INSPIRE can be discovered on this geoportal and in its metadata catalogue, visualised in the map viewer of the geoportal, and accessed or downloaded through web services. Since 2016, INSPIRE data are also accessible through the national open data portal. The establishment of this portal was one of the key open data developments in Luxembourg, together with the adoption of new open data legislation.

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. Currently there 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 develop a government system for geographical information was formulated in 1995. This framework, which is currently named 'SDI-Flanders', aimed to optimise the production, the management, exchange and use of spatial data in Flanders. The GIS decree of 2001 and the SDI Decree of 2009 provided the legal framework for the partnership. 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 members of this partnership. All partners are required by decree to contribute their geographical data to the GDI. Within the partnership 'SDI-Flanders', the regional Agency for Geographic Information Flanders (AGIV) was for a long time responsible for the operational coordination and exploitation of the Flemish SDI. While the development of the regional SDI already started in 1995, the first step towards a Flemish open data policy was taken in 2011, with the approval of the concept note on open data. In 2016, the Agency Information Flanders was created, integrating the AGIV into one main agency responsible for all government data.

Table 1 provides an overview of the legal and policy framework on spatial and open data, the leading organisations and the access points to data in the four cases.

The table shows how, in most cases, spatial data policies and open data policies were developed and implemented separately from one another. In most cases, also the organisations in charge and coordinating the work of other public administrations are different. However, an important development to align and integrate spatial data and open data policies recently took place in Flanders, with the integration of the bodies for coordinating both policies into one single agency, responsible for all types of government data. Also, important to note is the timing of the different initiatives. Especially in the Netherlands and in Flanders, initiatives and policies to promote the sharing of spatial data were implemented many years before an open data agenda and associated policies were introduced. Nevertheless, in some cases there also are clear linkages between the two domains and their legislation, policy documents and policy initiatives.

Although the focus of this chapter is not on the alignment between spatial data policies and open data policies, certain links between both and the efforts to integrate them will be addressed in this analysis, especially if they contribute to the realisation of a more open spatial data infrastructure.

Table 1 Policy framework, legal framework, leading actor(s) and main access point(s) for spatial data and open data in the four cases

	The Netherlands	Slovenia	Luxembourg	Flanders
Policy framework				
Open data	Vision and Action Plan on Open Government (2013a, 2013b)	Part of the Public Administration Development Strategy 2015–2020	Part of the Digital Luxembourg Initiative (2014)	Concept Note Open Data (2011) and Flemish Action Plan Open Data (2013)
Spatial data	GIDEON: Key geo-information facility for the Netherlands (2008) replaced by 'Partners in GEO' Vision (2014)	Originally part of eGovernment strategy 2013–2015, now eSpatial strategy 2016–2020	Luxembourg SDI (LSDI) project (2007)	SDI-plan 2011–2015 and Strategic programme 'Map of Flanders' (2012)
Legal framework				
Open data	Government Information Act (2006) changed to the Law on the reuse of public sector information (2015)	Public Information Access Act (ZDIJZ-E) (2006, amended in 2015)	Law on the reuse of public sector information (2007, amended in 2016).	Decree on the reuse of public sector information (2007, amended in 2015)
Spatial data	National INSPIRE law (2009) & Decision INSPIRE (2009)	Spatial Information Act (2010) & Amending the Infrastructure for Spatial Information Act (2015)	National INSPIRE law (2010, amended in 2014)	GIS Decree (2001) & SDI Decree (2009)
Leading actor(s)				
Open data	Ministry of the Interior and Kingdom Relations, Ministry of Economic Affairs, Ministry of Infrastructure and Environment	Ministry of Public Administration	Ministry of State	Coordination Cell Flemish eGovernment, now Agency Information Flanders
Spatial data	Ministry of Infrastructure and Environment, Geonovum	Ministry of the Environment and Spatial Planning, Surveying and Mapping Authority	Administration of Cadastre and Topography	Agency for Geographical Information, now Agency Information Flanders
Main access point(s)				
Open data	Data.overheid.nl (launched 2011)	Open Data Portal Slovenia (launched 2010)	Data.public.lu (launched 2016)	Flemish Open Data Portal (launched 2010)
Spatial data	National GeoRegistry (launched 2009) Public Services on the Map (launched 2011)	National INSPIRE geoportal (launched 2011) and several thematic portals	ACT's geoportal (launched 1997)	Flemish geoportal Geopunt.be (launched 2013)

Analysis of the governance of open spatial data infrastructures

This section discusses the use of different instruments to govern the relationships with non-government actors in the SDI and to engage these non-government actors in the development and implementation of the SDI.

Netherlands

Both the coordination structure and the strategic planning and management of the implementation of the SDI reflect the ambition to develop an open SDI. The most recent policy document, the 'Partners 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 (Bregt et al. 2014). Since Partners in Geo, the coordination structure fits 'the golden helix' construct with equal representation from the public sector, private sector and academia. The Top Team, consisting of the chairman of the public GI-Council, the president of the association of GI businesses and the chair of the Netherlands Centre for Geodesy and Geo-Informatics, discusses strategic issues. The tactical level is addressed by the strategic council, again with equal representation from the public sector, private sector and academia.

From the first stage of INSPIRE implementation, actors outside the public sector were closely involved in decision-making on the development and implementation of INSPIRE in the Netherlands (VROM/Geonovum 2010). The central steering committee of INSPIRE is advised by a consultative group, in which both INSPIRE data providers and users 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 a member of the steering committee.

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 harmonised and difficult to understand (VROM/Geonovum 2010). Therefore, the Netherlands started with the development of the '*Geo Gedeeld*' framework, which included a proposal to harmonise conditions for use (Van Loenen & Van Barneveld 2010). In the second phase of INSPIRE implementation, after 2010, the '*Geo Gedeeld*' framework was implemented as the standard license framework for INSPIRE data in the Netherlands. In 2014, it was decided to bring the Dutch INSPIRE data policy in line with international standards, and to apply where possible the Creative Commons framework (I&M/Geonovum 2016). A 'Creative Commons, unless' principle was introduced, which means governments now, for INSPIRE data themes, have to apply one of the Creative Commons licenses when making their data available, unless they want to impose specific conditions that the Creative Commons framework does not cover. In that case, they have to apply the '*Geo Gedeeld*' framework.

In 2011, the ambition was set in the Netherlands to make access to all public spatial 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

(I&M/Geonovum 2013). The Minister for Infrastructure and Environment declared in 2011 that it would open all government data under the remit of 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 launched, providing access to a large number of open datasets, including the datasets from the National GeoRegistry. All spatial datasets that are included in the National GeoRegistry and that can be classified as open data, are harvested by the National Open Data Portal. As a result, almost half of the open data in the Netherlands are spatial data. According to a report of the Dutch Algemene Rekenkamer (2014) approximately 95% of all spatial data in the Netherlands are available as open data.

Already in the preparation of INSPIRE implementation, the Netherlands started with estimating and measuring the costs and benefits of INSPIRE (VROM/Geonovum 2010). In 2009, a cost–benefit analysis was carried out on the implementation of INSPIRE in the Netherlands, in which a comparison was made of two alternative implementation models: a basic model, in which the impact of INSPIRE on organisations managing geo-information is kept minimal, and a collective model, in which all organisations managing geo-information in the Netherlands should make their data INSPIRE compliant (Ecorys & Grontmij 2009). 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 results of the cost-benefits were repeated and updated in the 2013 report, focusing on INSPIRE implementation between 2010 and 2012 (I&M/Geonovum 2013). The updated cost–benefit analysis demonstrated that the costs of INSPIRE implementation were significantly higher than was originally estimated (see Ecorys 2016). The main reasons for this were the lack of experience in implementing INSPIRE in 2009 and the complexity of INSPIRE. In addition to the assessment of the costs and benefits of INSPIRE, several cost–benefits analyses were undertaken in the Netherlands of particular spatial datasets, such as topographic data and elevation data (Bregt et al. 2013, 2016).

Slovenia

In Slovenia, the implementation of a more open spatial data infrastructure mainly took place in the latest phase of INSPIRE implementation and reporting. In the first years of INSPIRE implementation, private partners were considered to be relevant actors in the SDI, but only in the role of contractors of technically demanding tasks in establishing and operating the Slovenian SDI (Petek et al. 2010). Businesses could play an important role in the standardisation and harmonisation of data during data collection and maintenance processes. Good practices and experiences in other countries raised the awareness of the potential role of private companies as providers 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 non-government actors access to the data. The lack of a long-term and stable funding model was, however, seen as an important barrier in opening spatial data to actors outside government (Government of the Republic of Slovenia 2013). Therefore, the focus of the SDI in Slovenia for a long time remained on data-sharing among public sector bodies, and especially 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' (KULeuven/SADL 2011a). 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 (Government of the Republic of Slovenia 2013).

Several important changes towards making the Slovenian SDI more open took place between 2013 and 2015 (Petek 2016). 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 (Government of the Republic of Slovenia 2016). To ensure the correct and complete transfer of the INSPIRE Directive, several changes and supplements had to be introduced into the original ISI Act. For instance, changes were needed to the provisions on restrictions for public access to spatial datasets and network 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 organised through mutual agreements among data providers and data users, because of the changes in the legislation, such agreements are no longer 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 reuse 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 (Government of the Republic of Slovenia 2016).

Since 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 its strategy on e-commerce in public administration bodies (Petek 2014). In the latest phase of INSPIRE implementation, the activities to further develop and establish an SDI in Slovenia were embedded in a broader e-spatial 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 (Government of the Republic of Slovenia 2016). The e-spatial strategy itself was considered to be part of the broader e-government strategy in Slovenia. In order to realise 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 (Petek 2016). 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 to be stakeholders of the SDI in Luxembourg, in addition to several public administrations. It was argued that these research centres and universities could produce and maintain data that might become relevant for INSPIRE in the future (Konnen & Kaell 2010). This means that originally, private companies and citizens were not regarded as relevant stakeholders. Only the use of public sector data by engineering firms and architects in the scope of their projects was considered as a potential context in which private companies could take advantage of the SDI. In the second official INSPIRE report, private software producers were added to the list of stakeholders of the national SDI, although their precise role and how they would be involved in the SDI was not defined in detail (Kaell & Konnen 2013). Until 2013, the SDI in Luxembourg was mainly about facilitating and coordinating the exchange of spatial data among public sector organisations, and only public sector organisations were involved in decision-making processes on the SDI (KULeuven/SADL 2011b). This did not change in the latest phase of INSPIRE implementation. A recent development relevant in the light of realising a more open SDI was the establishment of a working group on spatial data policy, which aimed to develop a government-wide

spatial data policy (Kaell et al. 2016). The 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 transposition of the PSI 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 (Kaell et al. 2016).

Luxembourg law stipulated that spatial data could be shared free of charge between all the public authorities, which was done via a set of view and download services (Kaell & Konnen 2013). Spatial data were made available via spatial data services, but were only accessible from inside the official government network (UN-GGIM, 2016). 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 (Kaell et al. 2016). 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 datasets 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 datasets such as the cadastral map, topography and addresses were released as 'open and free services'. However, not all the datasets behind these services are free of charge. For instance, access to datasets such as cadastral data and topographical data still require certain fees to be paid. Some datasets were made available as open data. These included old version of datasets and new datasets 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 datasets and services that could be considered as open and free data, the ACT aimed to stimulate other data providers to open their data. It is expected that in the near future all datasets that can be accessed via existing geoportals will be available as open data (Kaell et al. 2016).

An important barrier to opening spatial data in Luxembourg is the lack of an official government-wide license framework or model for the reuse of data (Kaell et al. 2016). 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. In recent months, the Luxembourg's Spatial Data Infrastructure seemed to be heading towards the adoption of CC zero as a general 'licence' for its spatial data, for all datasets that are not explicitly put under other rules. However, this still needed to be decided and implemented in the context of the working group on data policy (Kaell et al. 2016).

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 reuse of data was rather uncommon, from the beginning actors outside the public sector were considered and treated as important stakeholders of the SDI (Member State Contact Point Belgium 2009). 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 (Vancauwenberghe 2013). 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 (KULeuven/SADL 2011c). 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 datasets that were made available to all partners of the Flemish SDI. This was organised by the AGIV, the coordinating body of the Flemish SDI, that concluded agreements with third parties regarding the dissemination of the geographical data of third parties to Flemish public authorities (Member State Contact Point Belgium 2009).

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 (Member State Contact Point Belgium 2013). By means of electronic 'viewers' public access to the data in the SDI was realised. However, making the SDI more accessible for commercial reuse was considered as a policy priority for the following 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 five licence models for the provision of open data by entities in Flanders (Flemish Government 2014). 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 reuse and an open data licence at a fair cost for commercial reuse.

After the introduction of an open data license framework, the Flemish government also implemented a monitoring approach for assessing and monitoring the availability, accessibility and reusability of its spatial datasets, as an extension of the official INSPIRE monitoring (Departement Informatie

Vlaanderen 2015). Also, information on the charges for data and the license model used was collected for all datasets. By the end of the 2012, 73% of the INSPIRE datasets 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 datasets would be accessible to the public. Commercial reuse was authorised for about 33% of the datasets. According to the latest information on the status of the SDI in Flanders, more than 80% of the approximately 140 identified datasets are currently made reusable, mainly through a Free and Open Data license. 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 (Member State Contact Point Belgium 2016). The aim of this agency is to support the Flemish government with its digitisation 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.

Findings and discussion

The aim of this chapter was to analyse how public administrations in Europe are dealing with the governance of their 'open' spatial data infrastructures. The analysis builds further on the instruments-based approach developed and used by Verhoest et al. (2007) for analysing coordination in the public sector. The analysis demonstrated that the instruments-based approach for analysing governance as introduced by Verhoest et al. is a relevant and useful approach for analysing governance of open data infrastructures, and open spatial data infrastructures in particular. Several of the instruments identified by Verhoest et al. are also used in the governance of open spatial data infrastructures. Strategic planning and evaluation, collective decision-making, reshuffling of competences and knowledge and information sharing all are commonly used instruments for the governance of open spatial data infrastructures. Also, regulation of the market, another instrument proposed by Verhoest et al. (2007), is relevant in the domain of open spatial data infrastructures. Both the development and use of license frameworks and the creation of data portals can be seen as instruments contributing to creating a market between data providers and data users. Based on our analysis of recent governance efforts and activities in the four cases, nine main governance instruments can be identified and used for the governance of open spatial data infrastructures in Europe. Table 2 gives an overview of these nine instruments and the way in which they have been implemented in the four cases.

Table 2 Governance instruments used for the governance of open spatial data
infrastructures

Strategic planning: Design of SDI strategies and actions plans addressing open spatial data or linked to open data strategies	**Netherlands**: Private sector and academic sector strongly involved in SDI strategies, in which open data are considered to be essential and the user is central **Slovenia**: Inclusion of spatial data and SDI in the national e-government and e-commerce strategies
Strategic evaluation: Assessing and monitoring the openness of the infrastructure (readiness, data, use, benefits)	**Netherlands**: Costs-benefits analyses of INSPIRE and of open spatial datasets **Flanders**: Regular monitoring of the accessibility, availability and reusability of spatial data, also to non-government users **All**: Collection of user statistics of geoportals and open data portals
Collective decision-making: Governance structure in which non-government actors have an advisory or decision-making role	**Netherlands**: Non-government actors involved in SDI decision-making through the Top Team and Strategic Council **Flanders**: Non-government actors involved in SDI decision making through participation in SDI Council **Slovenia**: Decision-making on spatial data integrated in decision-making on e-government and informatics
Reshuffling of competences: Assignment of tasks and competences in developing the infrastructure for non-government actors	**Netherlands**: Research programme to stimulate the involvement of research institutions in the infrastructure **Flanders**: Private companies as data provider to SDI, under data-sharing agreement with coordinating body of the SDI **Luxembourg**: Especially research centre and universities seen as (potential) data providers
Establishment of coordinating functions/ entities: Creation of coordination bodies or functions responsible for open spatial data and/or the alignment between open data and spatial data	**Flanders**: Integration of SDI coordinating body and open data coordinating body into single Agency Information Flanders, responsible for all government data and information
Knowledge and information sharing: Awareness-raising and capacity-building on open data and SDI among different stakeholder groups	**Flanders**: Awareness-raising on SDI and open data through information sessions within public administration and yearly events with public sector, private sector, academic sector and others **Slovenia**: Promotion and awareness-raising on INSPIRE and SDI through the organisation of joint events for public data providers, private companies and research institutions
Licenses: Use of open licenses for spatial data	**Netherlands**: Development of harmonised licenses framework and government-wide use of international license framework **Flanders**: Creation and use of standard license framework for all government data, including spatial data
Access mechanisms: Making spatial data discoverable and accessible through different mechanisms	**All**: Spatial data discoverable and accessible via geoportal and national open data portal
Legal framework: Regulations and laws on open spatial data	**All**: Transposition of INSPIRE Directive and revised PSI Directive into national legislation

The analysis revealed some important similarities and differences in the approaches adopted and the instruments used to govern the relationships with non-government actors. 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 from the start of SDI/INSPIRE implementation. In Slovenia and Luxembourg, the focus for a long time was mainly or even solely on public sector bodies, and non-government actors were only recently recognised as relevant actors in the SDI. This is also reflected in the governance structures of the SDIs. A 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. Luxembourg and Slovenia only recently started to consider a more open governance and decision-making structure.

Another difference can be seen in terms of the development of a government-wide license framework for spatial data and services. In all four countries, several geoportals and thematic viewers to provide citizens and other stakeholders access to certain thematic datasets were developed in the first phase of INSPIRE implementation. However, with regard to the actual reuse 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. The Netherlands was the leading country in the development of such a common license framework, followed by Flanders a few years later. Both governance instruments clearly illustrate the differences in timing between the four countries in their move towards a more open spatial data infrastructure, and the development of an appropriate governance model for such an open infrastructure. In Flanders and the Netherlands, governance instruments to actively involve non-government actors in the development and implementation of the infrastructure have been implemented from the start of SDI/INSPIRE. In Slovenia and Luxembourg, businesses and other stakeholders outside the public sector were only recently recognised as relevant actors in the infrastructure, and the implementation of instruments for governing the infrastructure in a more open manner is less widespread.

In addition to the modification of governance structures and the development of license frameworks, the analysis revealed several other instruments that are used to govern relationships with actors and parties outside the public sector. An instrument that has been employed in several countries 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 realisation of a more open spatial data infrastructure. Not only could actors not belonging to the public sector be closely involved in the preparation of the documents, the documents themselves could 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. While awareness-raising and promotional activities towards businesses, research institutions and other organisations are also often organised to promote the participation of these organisations in the infrastructure, another often used instrument to govern the relationships with these non-government actors is the establishment of an appropriate legal framework.

Conclusion

The aim of this chapter was to analyse how public administrations in Europe are dealing with the governance of their national spatial data infrastructures. The focus of this chapter was on the governance of open spatial data infrastructures in Europe. Three European countries (Netherlands, Luxembourg and Slovenia) and one region (Flanders) were included in the analysis. The analysis showed how all countries have taken certain measures to engage actors outside the public sector in the governance of the open spatial data infrastructure. Typical instruments used to govern the relationships between different stakeholders in the infrastructure, including businesses, research institutions, non-profit organisations and citizens, are the modification of decision-making structures, the development of strategic plans focused on the use of spatial data outside the public sector, the development and implementation of licensing frameworks and changes in the legal framework. The main differences between countries are both in the extent to which open governance instruments have been adopted and in the timing of the adoption of these instruments. While Flanders and especially the Netherlands have been aiming to implement governance instruments to make their spatial data infrastructure more open from the start of SDI/INSPIRE implementation, in Slovenia and Luxembourg the focus was for a long time mainly or even solely on public sector bodies, and non-government actors were only recently recognised as relevant actors in the SDI.

In its analysis of the shift towards more open spatial data infrastructures, the chapter also showed the impact of open data initiatives and policies on the establishment of these open SDIs. At European level, the revision of the PSI Directive clearly had an impact on open data policies, but also on spatial data policies in the different countries. At national and regional level, evidence was found of the impact of open data policies on the implementation of spatial data infrastructures and the opening of these infrastructures to non-government bodies. Open data license frameworks have been applied to spatial data, spatial data are made available through national open data portals and national SDI strategies were in line with the national open data strategies and policies. It can be concluded that some countries started with the implementation of an open spatial data infrastructure before the adoption of a national open data agenda, but in all countries in the analysis the national open data agenda clearly had an

impact on the spatial data infrastructure. However, a more systematic and in-depth investigation of the links and interplay between open data and spatial data policies and infrastructures is required to better understand how both domains are influencing each other. Also, the impact of existing and ongoing spatial data initiatives and policies on the development of open data policies since 2010 should be included in this analysis.

As for other technological and organisational components of open spatial data infrastructures, it can be argued that the implementation of appropriate governance instruments should not be seen as an end in itself. Rather, effective governance of the infrastructure should lead to or contribute to an increased availability of spatial data and services, a better use of these data and services, and the realisation of different types of benefits. In this way, the analysis presented in this chapter should only be regarded as a very first step in the analysis of the governance of open spatial data infrastructures. Determining the importance and impact of different governance instruments and governance models also requires a correct and complete assessment of the performance of open spatial data infrastructures, but especially an investigation of the impact of different governance models on the performance of these infrastructures. Much work has been done on developing and applying different frameworks and methods for the assessment of spatial data infrastructures (e.g. Grus 2013, Giff & Crompvoets 2008, Kok & Van Loenen 2005, Rodriguez Pabon 2005) and open data initiatives (e.g. Caplan et al. 2014, World Wide Web Foundation 2015, Open Knowledge International 2014), leading to a better insight in the performance of these infrastructures and initiatives.

While this chapter provides a first explorative analysis of how European countries and public administrations have taken actions and implemented instruments to make their spatial data infrastructures more open, some important conclusions can be drawn on the current state of openness of these infrastructures. Our analysis showed how European public administrations in recent years have moved towards more open spatial data infrastructures, through the adoption of common governance instruments, such as decision-making and consultation structures, re-shuffling of competences, and strategic planning and evaluation. Despite these efforts and implemented instruments, the level of openness of these infrastructures, however, still remains limited. So far, the development of spatial data infrastructures was especially successful in opening the spatial data, by increasing and improving the availability, accessibility and reusability of spatial data. Nonetheless, the openness of the infrastructure itself still is restricted, since government remains dominant in the development and implementation of spatial data infrastructures in Europe, and participation of and collaboration with non-government actors such as businesses, research institutions and other stakeholders still remains relatively low. In the past, governments have mainly been working on making their traditionally closed infrastructures more open,

but not on building a truly open spatial data infrastructure. An important and unsolved challenge in realising such an open spatial data infrastructure will be the governance of this infrastructure, which will require new and innovative governance approaches.

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